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ABSTRACT

This activity guide, developed to provide environmental education through a series of hands-on activities geared to Raven Rock State Park in North Carolina, is targeted for grades 5, 6, and 7 and meets curriculum objectives of the standard course of study established by the North Carolina Department of Public Instruction. Three types of activities are included: pre-visit, on-site, and post-visit. The on-site activity is conducted at the park, while pre- and post-visit activities are designed for the classroom. Major concepts included are: rock cycle geomorphology; formation of sedimentary, metamorphic, and igneous rocks; weathering and erosion, rock and mineral characteristics; and topography. Includes a vocabulary list, scheduling worksheet, parental permission form, North Carolina Parks and Recreation program evaluation and information about Raven Rock State Park. (MKR)

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RAVEN ROCK

THEN AND NOW

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Raven Rock State Park

An Environmental Education Learning Experience

Designed for Grades 5-7

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RAVEN ROCK

THEN AND NOW

Raven Rock State Park

An Environmental Education Learning Experience

Designed for Grades 5-7

"Talk of Mysteries!
Think of our life in nature
daily to be shown matter,
to come in contact with it –
rocks, trees, wind on our cheeks!
the solid earth! the actual world!
the common sense! Contact! Contact!
Who are we? Where are we?"

– Henry David Thoreau. 1848.
The Maine Woods

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CP&L

This Environmental Education Learning Experience
was developed by

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Lead Interpretation and Education Ranger
Raven Rock State Park

N.C. Division of Parks and Recreation
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The N.C. Department of Environment, Health and Natural Resources;

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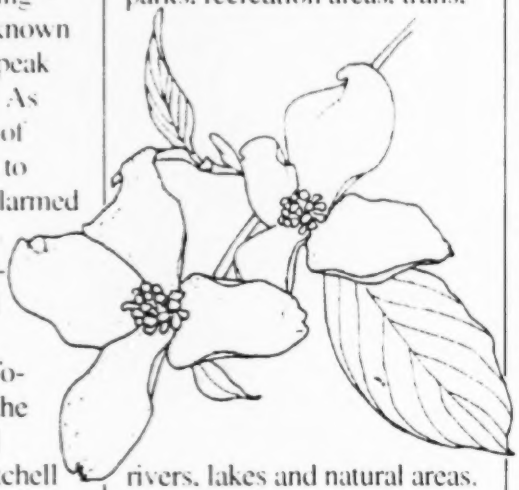
Introduction to the North Carolina State Parks System

Preserving and protecting North Carolina's natural resources is actually a relatively new idea. The seeds of the conservation movement were planted early in the 20th century when citizens were alerted to the devastation of Mount Mitchell. Logging was destroying a well-known landmark - the highest peak east of the Mississippi. As the magnificent forests of this mile-high peak fell to the lumbermen's axe, alarmed citizens began to voice their objections. Governor Locke Craig joined them in their efforts to save Mount Mitchell. Together they convinced the legislature to pass a bill establishing Mount Mitchell as the first state park.

That was in 1915. The North Carolina State Parks System has now been established for more than three quarters of a century. What started out as one small plot of public land has grown into 59 properties across the state, including parks, recreation areas, trails, rivers, lakes and natural areas. This vast network of land boasts some of the most beautiful scenery in the world and offers endless recreation opportunities. But our state parks system offers much more than scenery and recreation. Our lands and waters contain unique and valuable archaeological, geological and biological resources that are important parts of our natural heritage.



As one of North Carolina's principal conservation agencies, the Division of Parks and Recreation is responsible for the more than 125,000 acres that make up our state parks system. The Division manages these resources for the safe enjoyment of the public and protects and preserves them as a part of the heritage we will pass on to generations to come.

An important component of our stewardship of these lands is education. Through our interpretation and environmental education services, the Division of Parks and Recreation strives to offer enlightening programs which lead to an understanding and appreciation of our natural resources. The goal of our environmental education program is to generate an awareness in all individuals which cultivates responsible stewardship of the earth.

For more information contact:

N.C. Division of Parks and Recreation
P.O. Box 27687
Raleigh, NC 27611-7687
919/ 733-4181

Introduction to Raven Rock State Park

The Rock:

This landmark is rich in geological, natural and cultural history. Raven Rock State Park is located on what is called the fall zone, an area where the hard, resistant rocks of the foothills give way to the softer rocks and sediments of the coastal plain. The underlying rocks of the area were formed more than 300 million years ago by intense heat and pressure. Through the ages, flowing waters and swirling winds gradually eroded the land, carving and sculpting Raven Rock. This immense outcrop of gneiss rises approximately 100 feet and stretches for more than a mile along the Cape Fear River.

The rock was originally called Patterson's Rock for an early settler who found refuge there when his canoe capsized nearby. In 1854 its name was changed to Raven Rock, inspired by the sight of ravens which formerly roosted on the rock ledges.

Life Around the Rock:

Raven Rock State Park provides important habitat for a host of plants and animals. Wildflowers and shrubs, such as galax, mountain laurel and rhododendron, normally found in the mountains and foothills, find suitable habitat on the high river bluffs and moist ravines. Some of the largest trees in the park are found in the floodplain, where river birch, beech and sycamore are located. The flat, dry uplands are characterized by an oak/hickory forest, where sourwood, dogwood and blueberry make up the understory.

The many streams of Raven Rock create ideal habitat for aquatic invertebrates and fish. Salamanders are particularly at home along the river bluffs. The Piedmont forest and streams are home to many turtles, lizards and snakes. The copperhead snake is the only poisonous snake found in the park, but it is seldom encountered.

The spring migration brings many species of birds to the park. At the peak of the season, you can see as many as 20 species of warblers in a single day. Wood ducks nest in hollow trees along the river. Hawks, owls and woodpeckers may also be seen and heard.

Mammals are abundant in the park. Weasels, raccoons, squirrels, mice and shrews inhabit the woodlands, while beavers and muskrats live along the river and creeks. Several species of bats may also be seen as they hunt for insects.

History Highlights:

The Siouans and Tuscaroras hunted and camped in the area until European settlers arrived in the mid-1700's. The first settlers were primarily hunters and trappers, searching for high country similar to their native Scotland. These early settlers named the rock Patterson's Rock for Gilbert Patterson, who came to this country from Scotland and settled near Buies Creek in the 1740's. He obtained another piece of land near Pocket Creek in Lee County and traveled between his two parcels by canoe. On one of these trips, he wrecked his canoe and broke his leg at Norrington's Falls (now Fish Traps). He sought shelter under the large rock where he spent a couple of days without food. According to the legend, Patterson was on the verge of starving when a deer that was being chased by wolves jumped over the edge of the cliff and landed at his feet. He was able to live on venison until he was picked up a few days later by Native Americans canoeing through. After this incident, people began calling the cliff Patterson's Rock.

In time, stores, mills and quarries were built. Many of the woodlands were cleared and farmed. Later, many of these farms were abandoned and the forest regrew. The trees were then harvested a second time.

A road which stretched from Raleigh to Fayetteville crossed the Cape Fear River via the Norrington ferry and served as a major transportation route. Locks and dams were built along the river to facilitate navigation and Raven Rock became an important landmark for river pilots.

Some of the rocks near the river contain holes drilled many years ago when the rock was quarried. These holes were drilled into the rock by machines; dynamite was then placed in the holes and exploded to break apart the large boulders. It is thought that the rocks were used to build Norrington Lock and Dam at Fish Traps. A hurricane in 1859 destroyed the locks and dams, which were not replaced as the advent of the railroad eliminated the need for river travel. As bridges were built, the ferry was closed and Raven Rock became a popular recreation spot. The remnants of the Norrington Lock and Dam can still be seen in the park.

It is believed the rock obtained its current name of Raven Rock when ravens were observed nesting on the cliffs. Ravens are no longer found here, they still live in the western part of the state. Other accounts state that the rock was named "Reaven's Rock" as early as 1773, and one legend notes that the rock was named after an Indian known as Raven, son of Hancock, the Tuscarora Chief who led his warriors against the English during the Tuscarora War of 1711-13.

In 1965, it was suggested that the area be preserved as a state park and local citizens organized support for the project. In 1969, a bill establishing the park was passed in the General Assembly. Presently, the park covers over 3,000 acres.

Raven Rock's austere beauty is a testament to the forces that have shaped the land. As the river below rushes to join the sea, nature's elements continue to shape the surface of this natural monument.

Program Options:

Abounding with natural history, Raven Rock State Park is an excellent place to teach ecology, environmental issues, biology, conservation and earth science, as well as enjoy recreation.

Groups are encouraged to visit the park during all seasons of the year for hikes, exploration, nature study and other activities. Leaders may choose to design and conduct their own activities or use the Environmental Education Learning Experience activity

packet. Park staff will be happy to assist in your programming needs. Please contact the park office at least two weeks in advance for arrangements.

The American Beech Nature Trail is a self-guided interpretive trail with brochures available in a box at the trail entrance.

A Raven Rock State Park wildlife checklist is available from park staff.

Scheduling a Trip:

1. Please contact the park at least two weeks in advance to make a reservation.

2. Complete the scheduling worksheet provided at the back of the activity packet, on page 8.1.

3. The group leader should visit the park without the participants prior to the group trip. This will enable you to become familiar with the facilities and park staff, and to identify any potential problems.

4. The group leader should discuss park rules and behavior expectations with adult leaders and participants. Safety should be stressed.

5. Everyone should wear a name tag. Please color-code tags (for groups) and establish a buddy system.

6. Encourage everyone to wear appropriate, comfortable clothing and walking shoes.

7. The group leader is responsible for parental permission forms, located at the back of this packet on page 8.2, and the group's medical and health needs.

8. *If you will be late or need to cancel your trip, notify the park immediately.*

9. Research activity permits may be required for activities which require samples to be taken from the park.

10. Complete the pre-visit activities in the Environmental Education Learning Experience.

While at the Park:

Please obey the following rules:

1. To help you get the most out of the experience and increase the chance of observing wildlife, be as quiet as possible while in the park.

2. On hikes, walk behind the leader at all times.

3. When hiking the trails, exercise special care in areas with loose gravel, water bars, exposed roots or steps. Running and jumping are not permitted.

4. All plants and animals within the park are protected. Breaking plants and harming animals is prohibited in all state parks. This allows future visitors the same opportunity to enjoy our natural resources.

5. Picnic in designated picnic areas only. Help keep the park clean and natural; do not litter.

6. In case of accident or emergency, contact park staff immediately.

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Following the Trip:

1. Complete the post-visit activities in the Environmental Education Learning Experience packet.

2. Build upon the field experience and encourage participants to seek answers to questions and problems encountered at the park.

3. Relate the experience to classroom activities and curriculum through reports, projects, demonstrations, displays and presentations.

4. Give tests or evaluations, if appropriate, to determine if students have gained the desired information from the experience.

5. File a written evaluation of the experience with the park. Evaluation forms are available in the activity packet on page 8.3.

Park Information:

Raven Rock State Park
Rt. 3, Box 1005
Lillington, NC 27545
(910) 893-4888

Hours of Operation:

Nov - Feb	8:00 a.m.- 6:00 p.m.
Mar, Oct	8:00 a.m.- 7:00 p.m.
Apr, May, Sep	8:00 a.m.- 8:00 p.m.
Jun - Aug	8:00 a.m.- 9:00 p.m.

Other facilities in the area:

San-Lee Recreational & Environmental Education Park
PO Box 698
Sanford, NC 27330
(919) 776-6221

Introduction to the Activity Packet for Raven Rock State Park

The Environmental Education Learning Experience, "Raven Rock, Then and Now," was developed to provide hands-on environmental education activities for the classroom and the outdoor setting of Raven Rock State Park. This activity packet, designed for grades 5-7, meets curriculum objectives of the standard course of study established by the North Carolina Department of Public Instruction. It includes three types of activities:

- Pre-visit activity
- On-site activity
- Post-visit activity.

The on-site activity will be conducted at the park, while the pre-visit and post-visit activities are designed for the classroom. These activities may be performed independently or in a series, to build upon students' newly gained knowledge and experiences.

In these activities, students will have the opportunity to "make" sedimentary, metamorphic and igneous rocks; perform simple tests to identify rocks and minerals; and observe examples of chemical and mechanical weathering.

The Environmental Education Learning Experience, "Raven Rock, Then and Now," will expose students to the following major concepts:

- **Rock cycle**
- **Geomorphology**
- **Formation of sedimentary, metamorphic and igneous rocks**
- **Weathering and erosion**
- **Rock and mineral characteristics**
- **Topography**

The first occurrence of a vocabulary word used in these activities is indicated in **bold type**. These words and their definitions are listed in the back of the activity packet. A list of the reference materials used in developing the activities follows the vocabulary list.

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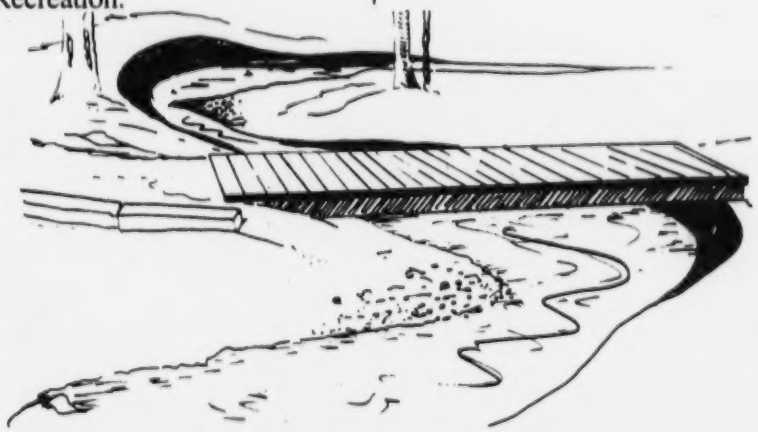
Note: On-site activities, weather permitting, will be held on Raven Rock Loop Trail. Students will be on the 2.2 mile trail for about two and one-half hours. They should dress appropriately (long pants, walking shoes). The students will be in areas where poison ivy, stinging wood nettle and ticks may be encountered. Contact is not likely if they follow the safety directions provided by the staff and stay on the designated trails.

Dilute acid may be used in the rock identification test and eye protection will be provided for all students handling the dilute acid. **Eye protection must be worn during the test!**

The educator will assist in seeing that all safety precautions are followed. It is also the responsibility of the educator to be aware of special considerations, medical needs, etc. of participants and be prepared to take appropriate precautionary measures. Park staff should be informed of any special considerations prior to the group's arrival.



Introduction to the Geology of Raven Rock State Park

The **geology** of Raven Rock State Park is unique in that the park lies on the **fall zone**. This is a narrow zone marking the boundary between the harder **metamorphic rocks** of the Piedmont and the softer **sedimentary rocks** of the Coastal Plain. This results in the occurrence of rapids, such as Lanier Falls and Fish Traps, in the principal rivers along this zone.

One theory on the formation of Raven Rock is that **sediments** were deposited in a shallow sea in this area 500 to 800 million years ago. Layers of sand, composed of **quartz**, **feldspar** and **mica**, fell to the sea floor. They compacted, forming sedimentary **rocks** called sandstone. About 300 to 500 million years ago, the deeply buried sandstone was changed by heat and pressure into metamorphic rocks, called **gneiss** and quartzite. Eventually, the metamorphic rocks were gently arched upward and exposed at the land surface by **weathering** and **erosion**.

Gravel layers or terraces can be found on the higher ridges in the park, particularly in the picnic area. This gravel is mostly rounded quartz cobbles, deposited by the ancestral Cape Fear River millions of years ago. These were probably carried from the higher piedmont region by the Cape Fear River and were gradually rounded as they journeyed along the river bottom. Some of the cobbles have a reddish color that is iron stain. The rocks in the park were exposed as the Cape Fear River continued to cut down through the gravels and metamorphic rocks.

The most prominent geologic feature in the park is Raven Rock. This is an outcrop of gneiss, rising approximately 100 feet above the river and running about one mile along the south bank. It has been carved by the erosional forces of the river. The hardness of gneiss and its resistance to erosion helped create these impressive exposures. In places, river banks are steeper on the south side of the river because of prevailing wind systems, **meander** development, rock structures controls, and the **Coriolis effect**. The Coriolis effect is the effect of the earth's rotation that causes winds and ocean currents to shift to the right or left of their expected paths.

Upon close examination, Raven Rock reveals some interesting geologic features. Light and dark colored layers of the rock represent changes in the composition of the sediments as they were deposited in the sea. In places, quartz **veins** can be found between the layers of gneiss. These veins originated as hot, silica-rich liquids that squeezed between fractures and then cooled and hardened into clear or cloudy quartz. A white **mineral**, feldspar, and shiny flakes of mica are also present. Some of the quartz veins are parallel (concordant) to the layers in the gneiss and others cut across (discordant) the layers in the rock.

Calcite, a soft white mineral, also occurs at Raven Rock. It has the chemical composition calcium **carbonate** and can easily be identified by using a dilute acid test. When dilute hydrochloric acid is placed on the mineral it bubbles (effervesces) as CO_2 gas escapes. This is similar to the bubbling effect when vinegar is placed on baking soda.

In places, the rock looks blocky and has one or more surfaces that are flat and straight, giving the appearance of having been cut by a saw. These are **joint** surfaces, or cracks in the rock, that formed as the overlying rock was removed by erosion or when the rock was folded. It is possible to see numerous parallel joints and other joints at different angles.

As a result of its geologic history, Raven Rock has played an important part in this area's cultural history. See the History Highlights in the Introduction to Raven Rock State Park for further information.

Activity Summary

The following outline provides a brief summary of each activity, the major concepts introduced and the objectives met by completion of the activity.

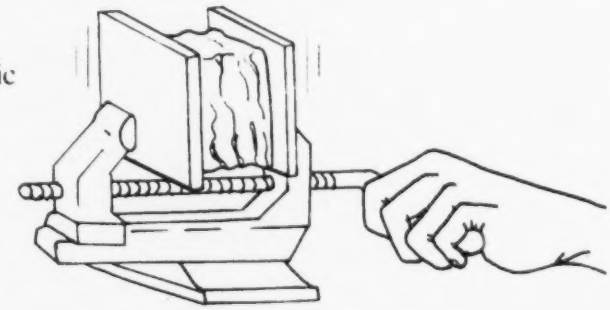
I. Pre-Visit Activity

#1 Hard Rock Crayola (page 3.1.1)

Using crayon shavings to simulate weathering and erosion, students will demonstrate the formation of the three basic rock types (sedimentary, metamorphic and igneous). This activity will also help the students understand the concept of the rock cycle, the process by which sedimentary, metamorphic and igneous rocks are transformed into and from one another.

Major Concepts:

- Rock cycle
- Mechanical weathering
- Formation of sedimentary, metamorphic and igneous rocks



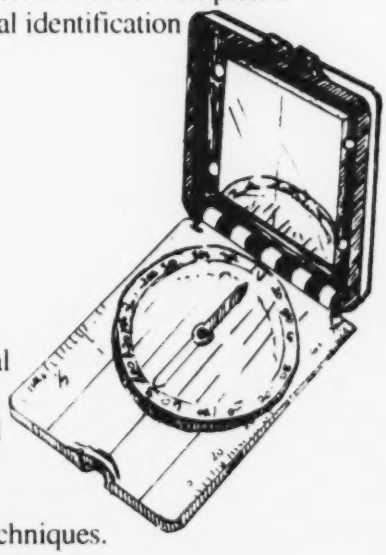
Objectives:

- List the three main rock types.
- Explain how each of these three rock types are formed.
- Describe the rock cycle.

II. On-Site Activity

#1 GeoTrek (page 4.1.1)

On this 2.2 mile hike, students will be introduced to the processes that formed Raven Rock by making direct observations of topography, weathering and erosion in order to complete a worksheet. A series of hands-on activities includes rock and mineral identification and compass reading.



Major Concepts:

- Weathering and erosion
- Rock and mineral characteristics
- Geomorphology

Objectives:

- Explain the difference between weathering and erosion.
- Distinguish two types of weathering.
- Describe how plants contribute to mechanical and chemical weathering.
- Describe the effects water has on mechanical and chemical weathering.
- Name the three basic rock types.
- Distinguish quartz from calcite using rock identification techniques.
- Define "fall zone" and explain what effect it has on river systems.

III. Post-Visit Activity

#1 GeoJeopardy (page 5.1.1)

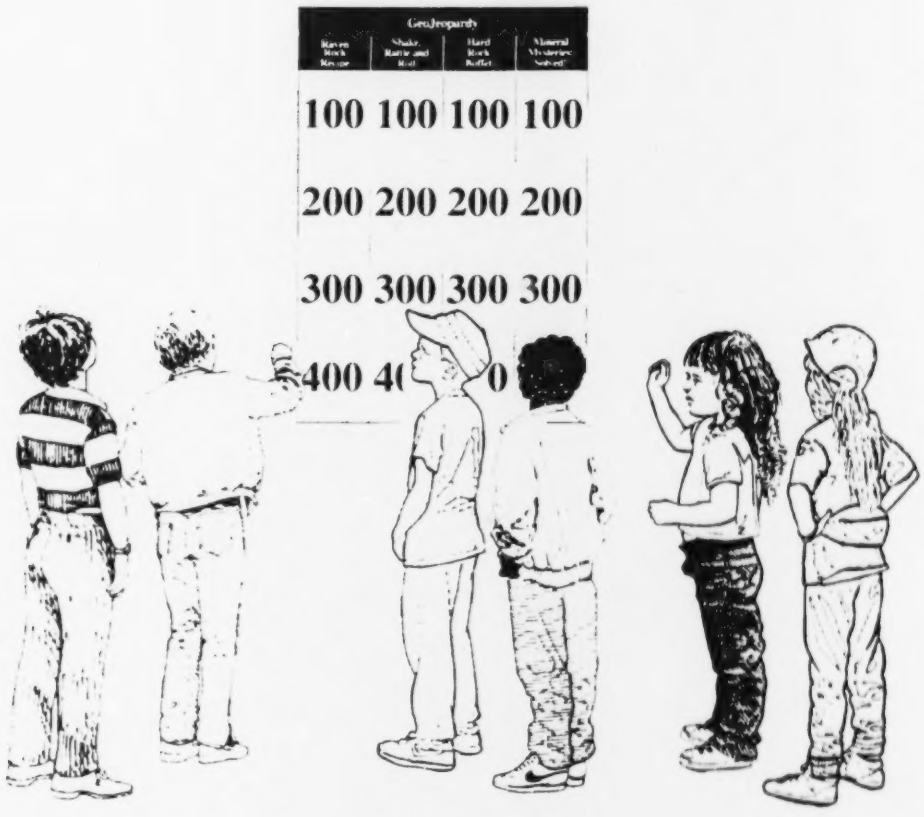
Involve the students in a fun game while reinforcing the objectives covered in previous activities.

Major Concepts:

- Basic rock types
- Weathering and erosion
- Rock and mineral characteristics

Objectives:

- List the three basic rock types.
- Describe how rocks change through weathering and erosion.
- Distinguish between rocks and minerals.
- Know the basic characteristics of select rocks and minerals.



Pre-Visit Activity #1 — Hard Rock Crayola

Curriculum objectives:

Grade 5

- Communication Skills: listening, reading, vocabulary and viewing comprehension
- Guidance: competency and skill for interacting with others
- Healthful Living: recreational and school safety
- Science: earth science, environment
- Social Science: organize and analyze information, draw conclusions, participate effectively in groups

Grade 6

- Communication Skills: study skills using environmental sources, listening, reading, vocabulary and viewing comprehension
- Guidance: competency and skill for interacting with others
- Healthful Living: recreational and home safety
- Science: earth science
- Social Studies: organize and analyze information, draw conclusions, locate and gather needed information

Grade 7

- Communications Skills: study skills using environmental sources, listening, reading, vocabulary and viewing comprehension
- Guidance: being responsible in a group
- Healthful Living: home, school and recreational safety
- Science: earth science, natural phenomena
- Social Studies: gather, organize and analyze information, draw conclusions

Location:
Classroom/science lab

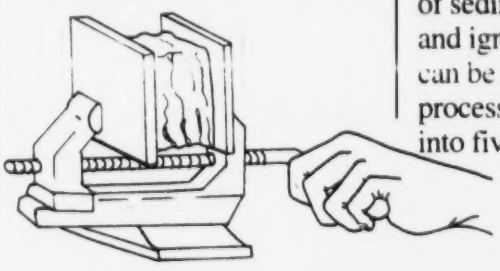
Group Size:
30 students or less, divided into six groups

Estimated Time:
Two to four hours

Credits:
This activity has been adapted from "Color Me Metamorphic" by Donald L. Birdd, *The Science Teacher*, April 1990, pp. 21-26.

Materials:
Provided by the educator:
Per group: hot plate, oven mittens, petri dish or finger bowl, aluminum foil (45cm x 45cm), three aluminum foil pie trays, wax paper, a metal or wooden trivet, newspapers
Per student: Rock Cycle and Hard Rock Crayola worksheets, safety goggles, pencil sharpener or carrot peeler, candles or four to six crayons of the same color (red, green, blue, or yellow), envelope
Per class: one or more vises with two boards (12.5cm x 20cm), rock samples.

Special Considerations:
Take proper safety precautions. The hot plate and hot crayon wax can cause burns. The vise can pinch/crush fingers.



Major Concepts:

- Rock cycle
- Mechanical weathering
- Formation of sedimentary, metamorphic and igneous rocks

Objectives:

- List the three main rock types.
- Explain how each of these three rock types are formed.
- Describe the rock cycle.

Educator's Information:

Many students have a difficult time understanding the abstract concept of the **rock cycle**, the process by which sedimentary, metamorphic and igneous rocks are transformed into and from one another. The students can see rock examples in the classroom; the difficulty lies in their inability to visualize just how these rock samples were formed. The following activity will give the students the opportunity to "see" the rock cycle through a series of simulations of mechanical weathering, erosion and formation of sedimentary, metamorphic and igneous rock. The activity can be done as one continuous process or can be broken down into five separate parts.

Instructions:

Set the stage by asking students to describe local rocks and/or rock formations. They have seen rocks during walks along a lake or river's edge, near or on a mountain, or during drives along roads that were built through road cuts. On the chalkboard, write down all the names and characteristics the students can remember about the rocks. Be sure to have several local rock samples distributed around the room.

Ask the students questions such as, "Have you ever wondered just how these rocks formed?" "Are new rocks forming at this moment?" Be sure to go over the **Rock Cycle** diagram. Discuss the three kinds of rock with the students.

Part A: Weathering

Cover all desk tops with newspaper. Give each student a sheet of wax paper, a pocket pencil sharpener or carrot peeler, and a candle or four to six crayons of the same color. The candles/crayons represent rock material, and the carrot peelers/pencil sharpeners represent weathering agents. Students should carefully shave each of the candles/crayons, keeping all of the fragments in a small pile. As they are "weathering" their candles/crayons onto the wax paper, call their attention to the size and shape of the fragments.

"Are they all the same size and shape?" (No.)

"Why or why not?" (They are not the same size and shape due to varied weathering forces upon them, i.e., how the sharpener or crayon is held, etc.)

"What are some of nature's weathering forces?" (Rain, flowing and freezing water, glaciers and wind.)

When the "weathering" is complete, the students should wrap their "sediments" in their wax paper and place each color in a separate envelope, unless you plan to do Part B of this activity right away.

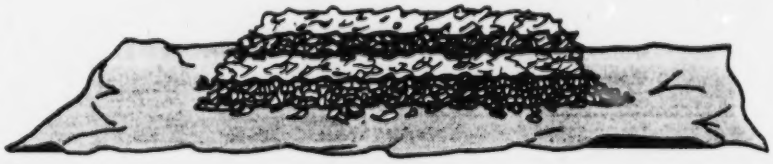
Part B: Erosion and Sedimentation

Once rock fragments have been created, they are usually moved by some force of nature. Here, the students act as the erosive force. Ask the students what this force of movement is called, and what some of its causes are. (Erosion, caused by gravity, moving water, glaciers and wind.) Place all the weathered "rock" fragments in four separate piles, one color to a pile. Divide the class into four (or eight) groups and give each group a sheet of aluminum foil (45 cm x 45 cm). Next, a student from each group should carefully transfer some "weathered sediments" of one color to the center of the foil. Spread the fragments into a 1 cm thick layer. Repeat with the remaining colors, layering the colors one on top of another.

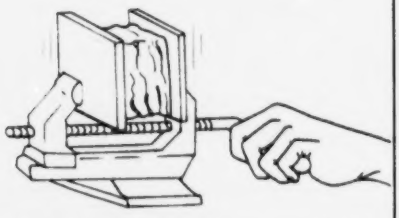
Students should record their observations of their layered "weathered sediments" on the "Hard Rock Crayola" worksheet. Fold the foil over the "sediments" layers, allowing for a 1 cm space all around the fragments, and then carefully fold the edges to seal the packages. If you are breaking the activity into sections, have the students label their foil packages by their group numbers and stop here.

Part C: Sediments/Sedimentary Rock Simulation

Unless you have more than one vise, this step will take some time and will require some patience. Each group will place their folded foil package between two boards. The "sandwich" should then



be placed in the vise. Apply light pressure with the vise to compress the "sediments." Once the "rock sandwiches" have been mildly compressed, remove them from the vise.



Students should then carefully open their packages and observe the new product. Call their attention to the central region which is more tightly compressed. The students should lift this portion from the non-compressed or more loosely packed "sediments" and carefully break it into two parts. Have the students look at the broken edges, then draw and describe the layers (on the worksheet).

How do they compare with the original loose "sediment's" layers? (They're similar, but much thinner.)

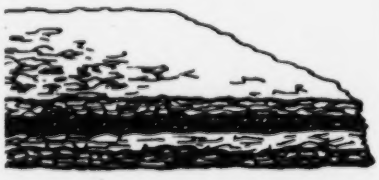
What happened to the spaces between the "sediments"? (Pressure from the vise forced the "sediments" closer together, eliminating the spaces.

Each group should transfer a few of their loose "sediments" and the smaller piece of "sedimentary rock" into a pie pan. Place the rest of the fragments in an envelope, (for part E). The pieces in the pie pan will be used for comparisons with the other "rocks" the students will produce during this activity. Return the larger piece of "sedimentary rock" to the aluminum foil package and wrap it up again. If you are breaking the activity into sections, stop here.

Part D: Metamorphic Rock Simulation

Place the foil package with the "sedimentary rock" between the two boards and put it into the vise again. Tell the students to add as much pressure to the vise as they can. This part of the activity demonstrates the need for great pressure to cause a rock to metamorphose. In reality, as the pressure deep within the earth increases, temperatures increase as well. A temperature change is probably occurring in this activity but is difficult to measure. (The heat associated with the formation of metamorphic rock is not a part of this activity.) Remind the students that metamorphic rock may become contorted in appearance. It may actually flow like a plastic material in response to the pressure from the rock load above and the movement of the earth's crust.

Have the students release the compression on the vise, remove the foil package and open it carefully to examine



the newly formed "metamorphic rock." They should carefully break this "rock" into two parts and examine it, noting what happened to the thickness and fragment shape. The students should write down their observations on their worksheet. (The different colored "rock fragments" or crayons will be squeezed together.)

Place the smaller piece of newly-made "metamorphic rock" with the "weathered sediments" and the "sedimentary rock" previously saved. If you are breaking the activity into sections, stop here.

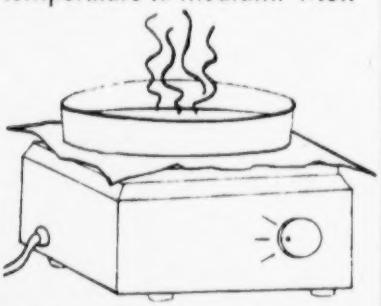
Part E: Igneous Rock Formation

SAFETY NOTE: This portion of the activity requires that the students be especially safety conscious as they will be working with a hot plate and melted wax.

Each group should line their last tray with aluminum foil.

For the "igneous rock" simulation, the groups should place the "sediment" fragments they set aside in envelopes and the larger piece of "metamorphic rock" into their aluminum tray. **Be Especially Careful Here!** This part of the activity requires a hot plate as a heat source. **Students Should Avoid Dropping Wax Fragments on the Hot Plate Surface or Themselves.** The students or teachers doing this portion of the activity should wear protective oven mittens

to avoid being burned. Cover each hot plate surface with a layer of foil before you turn it on. (This will diffuse the heat from the coils of the hot plate so the crayons will not burst into flames.) Each group should place their tray of "weathered sediments" and "metamorphic rock" on the hot plate and turn the hot plate temperature to medium. Melt



the wax, being careful that the melting process does not occur so rapidly that the molten wax splatters or burns. When most of the "rock" and "sediments" are molten, turn the hot plate off and carefully remove the tray, using the oven mittens. There is enough heat energy in the molten wax to melt the remaining solid mass. **Caution: Do not heat the wax to the splattering point!**

While the wax is still in the molten state, a student from each group, or the teacher, should CAREFULLY place the pan on the trivet.

Students should make observations of their tray, and draw and write these down on their worksheet. Comparisons should be made between these "igneous rocks" and the "rocks" and "sediments" made in the previous sections of this activity.

Set aside all "igneous rock" trays until the next day's class; the materials must sit overnight. This will allow the wax to cool. The next day, have the students carefully remove the "igneous rock" from the tray. Be sure to look at the lower surface of the "rock."

As a class, be sure to discuss the different rates of cooling of lava or magma. Lava flowing into the ocean around Hawaii can cool in a matter of hours. The magma that cools underground may take hundreds or thousands of years.

Mention that all conditions for rock formations cannot be simulated. In fact, geologists have never "seen" intrusive igneous rocks form. However, they are able to look at all of the available evidence, simulate some of the conditions in the laboratory, and arrive at results similar to those found in nature.

Reiterate the concept of the rock cycle by reminding them of the "rocks" (crayons or candles) that were weathered down into "sediments," compressed into "sedimentary rock" and then "metamorphic rock" and then melted into "igneous rock."

Student's Information

Rocks are divided into three main types: sedimentary, metamorphic and igneous.

Sedimentary Rock - rock formed by the compaction and cementing of **sediments**.

Sediments are small particles that have been weathered, or eroded, primarily from igneous and/or metamorphic rocks. The sediments were deposited in layers on land or on the bottom of lakes, rivers or oceans. Over time, the immense pressure from the weight of the layers above pressed the materials below into rock.

The rocks of Raven Rock began with sediments and a shallow sea 500 to 800 million years ago. Layers of sand, composed of **quartz**, **mica** and **feldspar,** fell to the sea floor. These grains were naturally cemented together to form sedimentary rocks called sandstone. Natural cementing agents can include **calcite**, silica and iron oxide. All of the original sedimentary rocks were transformed into metamorphic rock; there are no sandstones at Raven Rock.

Metamorphic Rock - rock that was formed by heat and pressure beneath the earth's surface.

Over a long period of time, heat and pressure alters a pre-existing rock's structure or texture. The metamorphic change takes place in a solid, rather than a molten, state and produces a harder rock with different qualities than the original.

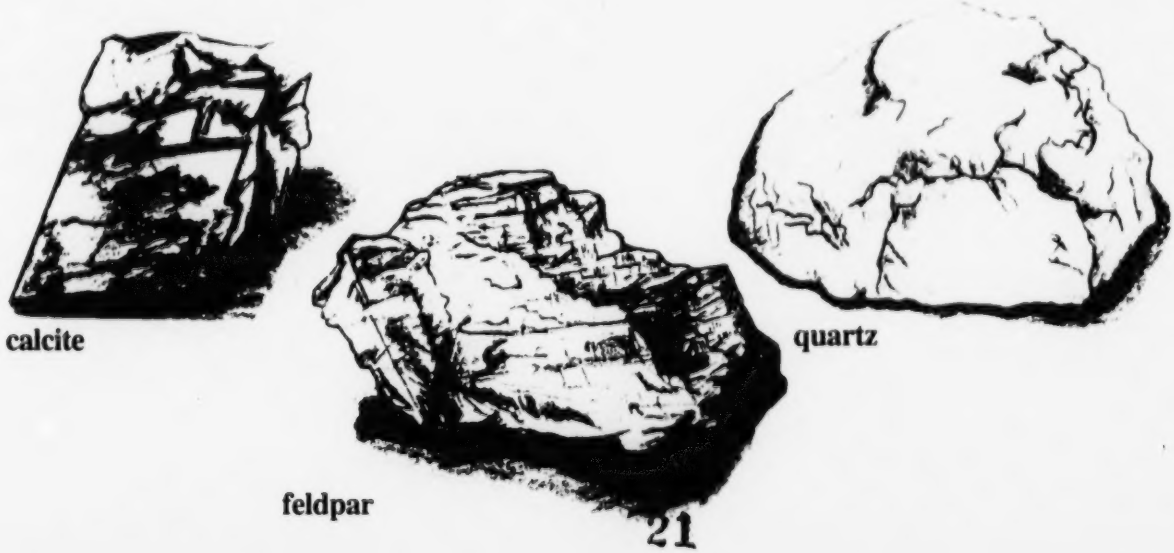
Metamorphosis means a transformation, a marked change in appearance or condition. An example, with which you will be familiar, is that of a caterpillar changing, or metamorphosing, into a butterfly.

The formation of metamorphic rocks at Raven Rock occurred 300 to 500 million years ago as the deeply buried sandstone was changed by heat and pressure to make metamorphic rocks called **gneiss**. These rocks were arched upward and eventually exposed by the processes of **weathering** and **erosion.**

Igneous Rock - rock which has solidified from a molten state.

Igneous rocks form deep within the earth in **magma** chambers embedded in solid rock. They may be **intrusive** or **extrusive** in nature. Magma which cools and stays within the earth is intrusive. Magma which is spewed out by volcanoes, lava for example, is extrusive.

Igneous rocks are not generally found in the area of Raven Rock due to its location during the time of volcanic activity.



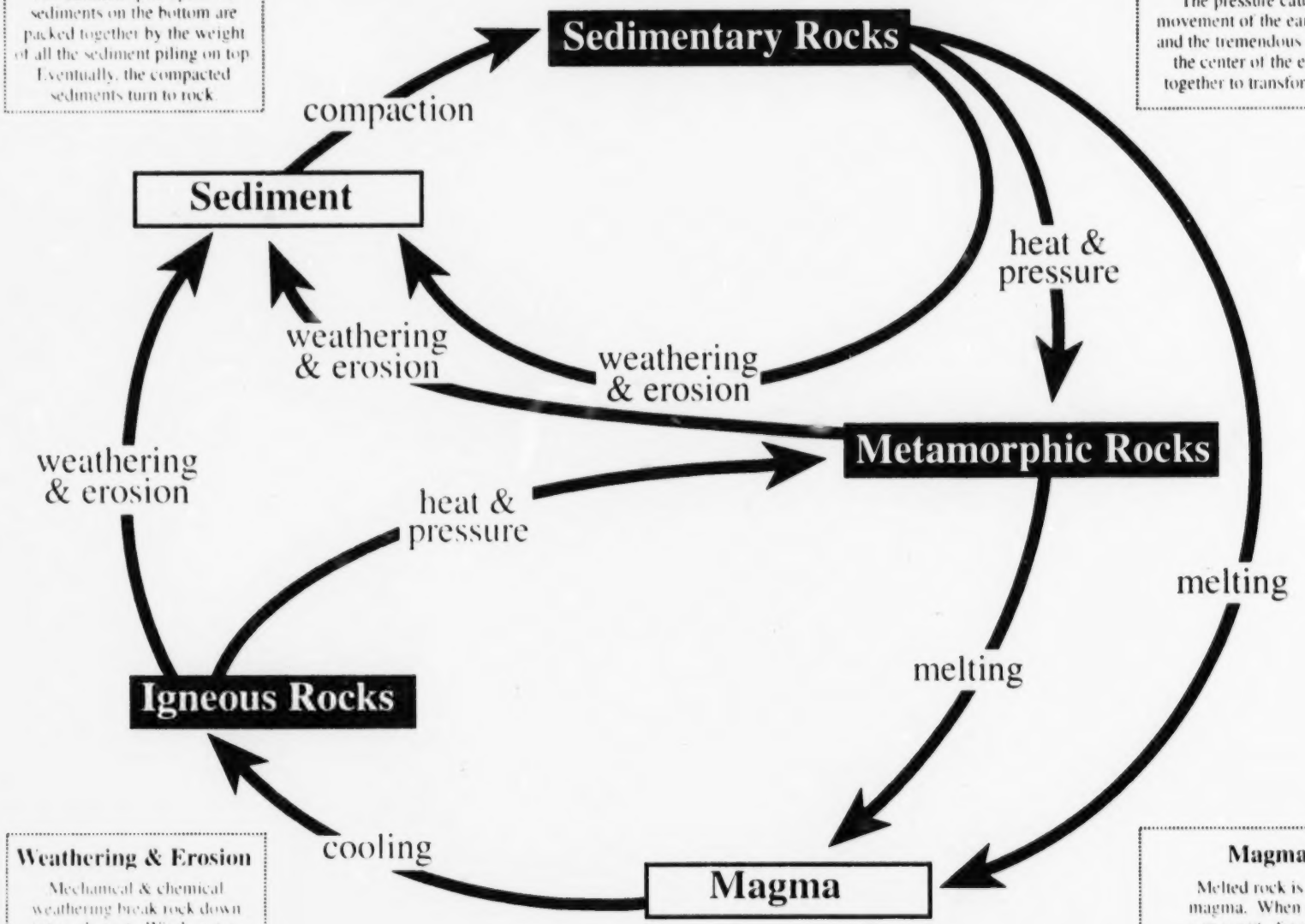
calcite

quartz

feldpar

21

Rock Cycle Worksheet



Compaction

As sediments pile up, those sediments on the bottom are packed together by the weight of all the sediment piling on top. Eventually, the compacted sediments turn to rock.

Heat and Pressure

The pressure caused by movement of the earth's crust and the tremendous heat from the center of the earth act together to transform rocks.

Weathering & Erosion

Mechanical & chemical weathering break rock down into sediment. Wind, water, ice and snow cause erosion.

Magma

Melted rock is called magma. When magma comes out of a volcano, it is called lava.

Worksheet for Pre-Visit Activity #1 Hard Rock Crayola

1. Describe and draw the "weathered sediments" that you made. Note the sizes and shapes of the "sediments."

2. Make a colored drawing of the "rock fragments" after light pressure has compacted these "sediments" into "sedimentary rock." Describe the broken edge and the layers that are formed.

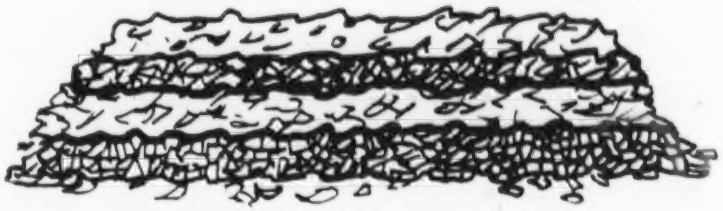
3. Make a colored drawing of the "sedimentary rock" after heavy pressure has compacted it into "metamorphic rock." Describe the broken edge and the layers that are formed. How have they changed with the addition of heavy pressure?

4. Draw the melted wax formation created in Part E.

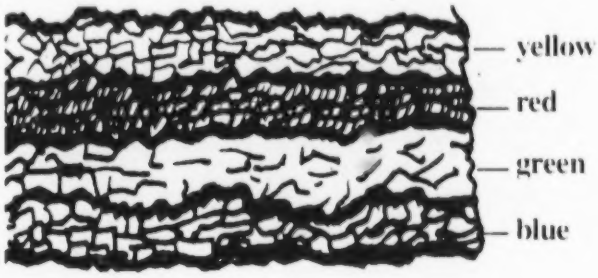
5. Write a comparison between the "weathered rock fragments," "sedimentary rocks," "metamorphic rocks" and "igneous rocks" formed in this activity. Compare and contrast them as to color, crystal size, texture, form and formation.

Answer Sheet for Pre-Visit Activity #1 Hard Rock Crayola

1. Describe and draw the "weathered sediments" that you made. Note the sizes and shapes of the "sediments."

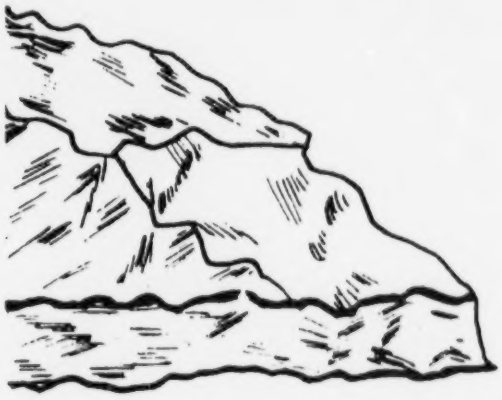


2. Make a colored drawing of the "rock fragments" after light pressure has compacted these "sediments" into "sedimentary rock." Describe the broken edge and the layers that are formed.



3. Make a colored drawing of the "sedimentary rock" after heavy pressure has compacted it into "metamorphic rock." Describe the broken edge and the layers that are formed. How have they changed with the addition of heavy pressure?

4. Draw the melted wax formation created in Part E.



5. Write a comparison between the "weathered rock fragments," "sedimentary rocks," "metamorphic rocks" and "igneous rocks" formed in this activity. Compare and contrast them as to color, crystal size, texture, form and formation.

The "weathered rock fragments" will vary in size and shape depending on the implement used. The "sedimentary rocks" will be bound together very loosely and individual "rock fragments" can be oriented (up/down or right/left) in any direction. In "metamorphic rocks" the space between fragments is very small and the orientation of fragments is now flattened (right/left). The thickness is much thinner, but each layer of rock (color) can still be seen. The "igneous rock" is grayish-black (melting and mixing of different "rock fragments").

On-Site Activity #1 — GeoTrek

Curriculum Objectives:

Grade 5
- Communication Skills: listening, reading, vocabulary and viewing comprehension
- Guidance: competency and skill for interacting with others
- Healthful Living: recreational and school safety
- Science: earth science, environment
- Social Science: organize and analyze information, draw conclusions, participate effectively in groups

Grade 6
- Communication Skills: study skills using environmental sources, listening, reading, vocabulary and viewing comprehension
- Guidance: competency and skill for interacting with others
- Healthful Living: recreational and home safety
- Science: earth science
- Social Studies: organize and analyze information, draw conclusions, locate and gather needed information

Grade 7
- Communications Skills: study skills using environmental sources, listening, reading, vocabulary and viewing comprehension
- Guidance: being responsible in a group
- Healthful Living: home, school and recreational safety
- Science: earth science, natural phenomena
- Social Studies: gather, organize and analyze information, draw conclusions

Location:
Raven Rock Loop Trail

Group Size:
30 students or smaller

Estimated Time:
2 hours, 15 minutes

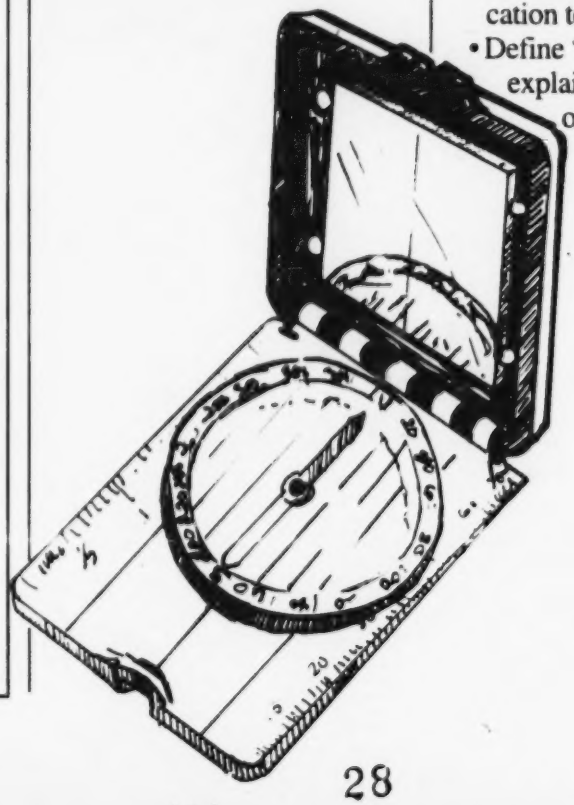
Appropriate Season: Any

Special Considerations:
This activity will involve a 2.2 mile hike lasting 2 hours, 15 minutes. Dress appropriately and wear suitable shoes

Materials:
Provided by the park:
rock samples, rock test kit, compass
Provided by the educator:
GeoTrek worksheets (one per student), pencils

Major Concepts:
- Weathering and erosion
- Rock and mineral characteristics
- Geomorphology

Objectives:
- Explain the difference between weathering and erosion.
- Distinguish two types of weathering.
- Describe how plants contribute to mechanical and chemical weathering.
- Describe the effects water has on mechanical and chemical weathering.
- Name the three basic rock types.
- Distinguish quartz from calcite using rock identification techniques.
- Define "fall zone" and explain what effect it has on river systems.



Educator's Information

This activity involves a hike to Raven Rock. Prior to arrival, safety concerns should be discussed and the students should be divided into three groups for rotation among the stations at the rock. Bathroom facilities are located near the main parking area. Should any "emergencies" occur, there are pit toilets located near Raven Rock.

The students will stop at stations on the hike to make observations and to answer questions on the "GeoTrek" worksheet. At Stations 1 and 2, students will observe stream **erosion** and **deposition**. At the base of the rock, they will rotate among the next three stops. Station 3 will involve identification of **minerals** and **rocks** common at Raven Rock. Students will observe the effects of **mechanical weathering** at Station 4. At Station 5, students will study a **topographic map** of Raven Rock and observe the role of topography and **chemical weathering** in developing diverse habitats. The final stop, Station 6 is located at the overlook and provides a vantage point to see some of the rapids prominent along the **fall zone**. Here, students will make comparisons to Station 2 regarding erosion and deposition. From this point, the students will return to the parking lot where they can retrieve their picnic lunch from the bus. Students should picnic in the designated area, not in the parking lot. A map showing the hiking route is included on page 4.1.7.

Station 1:
Gravel Deposition

Before leaving the picnic area, you will notice a large number of rocks beneath your feet. Their characteristics tell us a little bit of what has happened here. The **abrasion** of rocks against one another and against other **sediments** produces these rounded cobbles. This is what remains of an old river bed, possibly the ancestral Cape Fear River. People have taken advantage of these deposited rocks by mining them from nearby locations for decorative stone and other uses. Many of the rocks have a reddish, rust-like stain caused by **oxidation**. Iron-rich water penetrated the rock, then the iron rusted or oxidized.

Station 2:
Stream Erosion and Deposition

Here you can see a typical stream. Looking in the stream bed, you can see that it has rocks shaped very similarly to those in the picnic area. You can also see erosion and deposition taking place. Remember, there is a difference between **weathering** and erosion. Weathering is the process whereby rocks are broken down. Erosion is the movement of weathered rock and soil from one place to another. Deposition is the process by which materials, carried by wind, water, ice or gravity, are dropped elsewhere.

Watch the flow of water. When water enters a curve, the water on the outside goes faster than the water on the inside of the curve. The faster the water, the greater the erosion and the deeper the channel. As the process continues, stream banks can move sideways as one side is eroded and the other side is added to by deposition. This process can create a **meander**. Some older rivers meander so much that the river may curve back on itself creating an island or oxbow lake.

Station 3
A: Minerals

Raven Rock is made of several kinds of rocks and minerals. What is the difference between a rock and a mineral? A rock is made of one or more **minerals**. A mineral is a naturally occurring substance composed of one or more **elements**. All minerals

share four characteristics:

1) all are solid;
2) they form naturally;
3) each kind of mineral has a definite chemical composition no matter where the mineral occurs; and
3) atoms of minerals are connected to one another in an orderly, repetitive arrangement. This is what forms a mineral's characteristic **crystal** shape.

The kinds of atoms and the way they are bonded give each mineral a unique set of properties. The following tests describe ways to determine some of these properties. Several properties must be observed because no single test can be used to identify a mineral.

Hardness

You can use a scale of hardness (see the "Mineral Fact Sheet," page 4.1.9) to test the hardness of any mineral. On this scale, 1 represents the softest mineral, talc, and 10 represents the hardest mineral, diamond. Each mineral on the scale can be scratched by any mineral with a higher number. **Quartz** will leave a scratch on **calcite** but quartz cannot be scratched by calcite. You can perform the hardness test without having a sample of each mineral on the scale. Suppose you have a mineral that scratches your fingernail but is scratched by a penny. The mineral has a hardness between 2 and 3. You can then look up all the minerals with that hardness and narrow down the choices.

Color

A few minerals can be identified by color. For example, sulfur and gold are yellow, azurite is blue and malachite is green. However, color is not a very reliable test for identifying most minerals. Quartz can occur in a variety of colors, due to small amounts of iron, titanium, nickel or other elements present when the quartz formed.

Luster

A mineral's **luster** is the way its surface reflects light. It can shine like a metal or can appear greasy, glassy, pearly or dull. Like color, a mineral's luster can vary from sample to sample.

Streak

A more reliable test than color is **streak** – the color of a mineral when it is ground into a fine powder. This test is done by rubbing a mineral across an unglazed piece of porcelain called a streak plate. The streak color usually remains the same even though the mineral color may vary from sample to sample. Since the plate has a hardness of 7, this test is only good on minerals with a hardness less than 7.

Crystal Shape

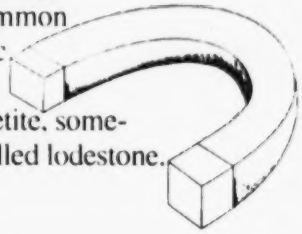
Crystals are formed when a liquid containing various elements cools to form solid minerals. Those liquids that cool slowly in an unrestricted space crystallize best. If a mineral sample is a well-developed crystal, its crystal shape is an important clue to its identity. Quartz crystals appear in many sizes but the angles between corresponding crystal faces are always the same with six sides of equal width.

Cleavage and Fracture

Observing the way a mineral breaks can help you identify it. If a mineral breaks along one or more smooth, flat surfaces, it has **cleavage**. **Mica** splits, or cleaves, easily into sheets because the bonds that hold the sheets to each other are very weak, while calcite cleaves into blocks. Some minerals do not have cleavage. They splinter, break unevenly or break along curved surfaces and are said to **fracture**. Flint produces a curved fracture – important to the Native Americans in constructing spear points and arrowheads.

Magnetism

A few minerals that contain iron are magnetic. The most common magnetic mineral is magnetite, sometimes called lodestone.



Density and Specific Gravity

Each mineral has a unique **density**. The higher a mineral's density, the more tightly its atoms are packed. You can compare densities of some minerals by comparing how heavy pieces of the same size feel. Galena, used to make lead, feels much heavier than the same size piece of talc. To compare densities accurately, scientists use specific gravity. This compares a mineral's density with the density of water. For example, gold has a specific gravity of 19.3, meaning it is 19.3 times more dense, or heavier, than the same volume of water.

Acid Test

Most **carbonate** minerals give off carbon dioxide gas when drops of dilute hydrochloric acid (HCl) are placed on the sample. This is especially true of the mineral calcite (calcium carbonate). Calcium carbonate is the active ingredient in "Tums™," an antacid used to neutralize stomach acid. When you mix vinegar (acid) and baking soda (sodium bicarbonate), they produce the same effervescence, or bubbling, due to the release of carbon dioxide.

Unusual Properties

Minerals can exhibit unusual properties. Quartz and calcite crystals can cause a double image. Some minerals give off colored light when exposed to ultraviolet light.

Whether identifying minerals in the classroom or in the field, you must observe more than one property. All minerals share some properties, but each has its own unique set of properties.

B: Rocks

Metamorphic rocks form from other rocks buried deep inside the earth, where changes in appearance and/or mineral content occur. **Gneiss**, the primary rock in the park, was formally another type of rock.

Geologists classify metamorphic rocks into two main groups: **foliated** and non-foliated. In foliated metamorphic rocks, minerals have been rearranged into visible layers or bands. The banding in gneiss comes from the separation, caused by intense heat and pressure, of dark mica from the lighter colored quartz and **feldspar**. Gneiss does not split as well as some other foliated metamorphic rocks such as slate or schist because it contains less mica and other minerals with cleavage.

Non-foliated rocks do not show layering or banding. **Sedimentary rocks,** such as limestone or sandstone, that are composed of only one mineral result in non-foliated meta-morphic rocks. The crystals combine to form larger, interlocking crystals resulting in a rock that is often stronger and coarser in texture than the rock from which it formed. Quartzite is metamorphosed sandstone. It resembles marble in appearance but is much harder. Quartzite can be distinguished from sandstone by looking at how it breaks. In sandstone, the breaks go around the crystals; whereas, in quartzite the break goes through the quartz crystals, leaving a smooth surface.

Another rock found in the park is pegmatite. Pegmatite is a very coarse-grained rock that crystallizes from **solutions** formed underground. This "liquid rock" is very fluid so the rock-making minerals (quartz, feldspar and mica) can crystallize in coarse masses. The pegmatite at Raven Rock is rich in feldspar, whose cleavage gives the rock a blocky appearance.

Station 4:

Mechanical Weathering

Weathering and erosion are constantly at work, wearing away the rocks that make up the earth's crust. Weathering is the process by which rocks are changed and broken down at the earth's surface by exposure to air, water, temperature changes, plants, animals and bacteria. There are two types of weathering, mechanical and chemical, which usually operate together, although one type might be more evident.

Mechanical weathering breaks rocks apart without changing their mineral composition. The rocks piled at the

base of Raven Rock were broken off from the cliff and still have the same mineral composition.

Almost every rock outcrop like Raven Rock contains a large number of cracks, called **joints**. Most joints are produced within the Earth when rocks are compressed, raised or pulled apart. Joints may be no wider than a hair, but provide an important starting point for the mechanical breakdown of the rock. As the pressure of overlying rocks is removed by erosion, joints begin to widen and the rock begins to expand. As the joints open, weathering agents act on them. Water may seep into these cracks and, if it is cold enough, the water freezes and expands. The expanding ice acts like a wedge, widening the joints. As the ice melts, water fills in these newly expanded areas and the process repeats, as long as freezing weather alternates with warmer weather.

Plants do their share of mechanical weathering. Plants can start growing in the small bits of soil that collect in the cracks. As the plant's roots grow, they force the cracks to deepen and widen. Eventually roots can split apart rocks – even large boulders. Even the root-like structure of mosses make a contribution, clinging to rocks and loosening individual grains.

Abrasion, as by avalanches and rock slides, also results in mechanical weathering, breaking rocks up as they collide with one another. Water force causes pebbles or cobbles to bump together, resulting in rounded rocks.

Man also "weathers" rocks. During the 1850's some of Raven Rock was used to construct the Norrington Lock and Dam. Holes were drilled into the rock for explosive powder, which was placed in the holes and exploded to break off sections of rock. Some of these holes can still be seen in the rock pile.

Station 5

A: Chemical Weathering

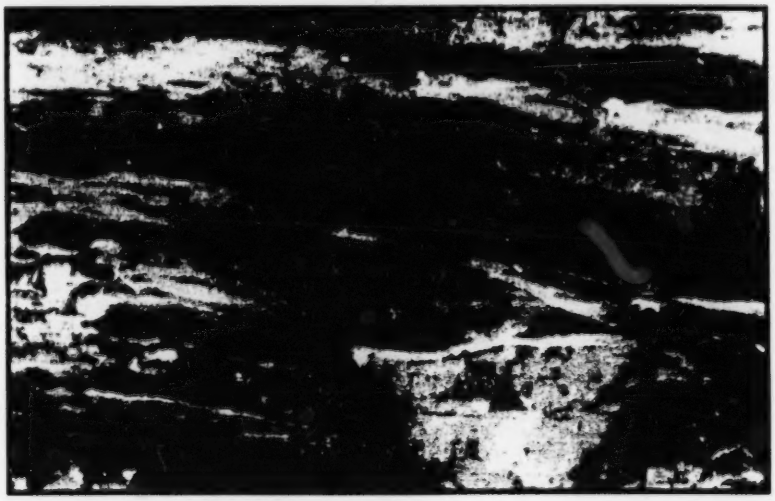
During chemical weathering, the minerals in rocks react with substances in the environment, such as water, oxygen or acids to form new substances. Water is the most important agent of chemical weathering.

Water that seeps into rocks may dissolve minerals and wash them away in a process called **leaching**.

In a process called **hydration**, water combines with the minerals on the outside of a rock. This weakens the bonds between the minerals making the rock brittle, more easily broken and weathered. Eventually, this weakened area flakes off, usually resulting in the formation of clay soils.

Oxygen can combine with certain minerals in a process called **oxidation**, forming new substances called oxides. Iron oxides, or rust, are usually responsible for the yellow or red color of soils and clays.

Water, by itself, may not dissolve rocks, but it often combines with certain gases, forming an acid that does react chemically with minerals. For example, rain and groundwater combine with carbon dioxide and form carbonic acid – the same acid found in carbonated soft drinks. As this weak acid trickles through the ground, it dissolves certain minerals or entire rocks and carries them away in solution. Carbonic acid completely dissolves calcite. Calcite is the



principal rock-forming mineral in limestone. As limestone dissolves away underground it leaves huge underground caverns.

The decay of plants and animals also produces acids that contribute to chemical weathering. Some living organisms, such as lichens, produce acids as they grow.

Several factors influence how fast a rock weathers chemically and mechanically. One factor is the number and size of joints. A large number of cracks increases the surface area exposed to weathering agents.

Climate is a very important factor in determining the rate of weathering. **Ice wedging** depends on many episodes of thawing and freezing to effectively weather rocks and chemical weathering occurs much more rapidly in moist climates than dry ones.

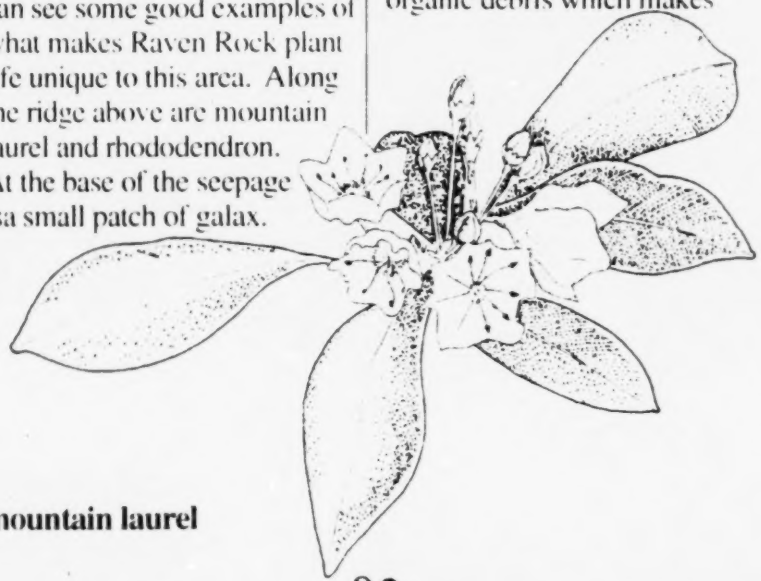
Another important factor of weathering rates is the mineral content of the rock. Quartz, for example, is extremely resistant to chemical and mechanical weathering. Often you can see piles of quartz boulders deposited in one spot where the surrounding rock has long weathered away. Quartz sandstones are among the most durable of all rocks while limestone, composed of calcite, weathers easily in moist climates.

B: Topography and Plant Habitats

It takes a special map to really show the landscape. Maps that do this are topographic, or contour maps. Each line in the map is called a **contour line**. The lines show how high the land is above sea level, and connect all points of equal elevation. The vertical distance between each contour line is called the **contour interval**. Together, all of the contour lines on such a map represent the shape or contour of the land area that the map portrays. The closer together the lines, the steeper the slope. Notice the similarity of the river banks with those of the small stream. As with the stream, weathering, erosion and deposition are taking place here, but on a larger scale.

Topography is important in determining what plants can grow in a given location because it limits their drainage and moisture, and the amount of sun they receive. Here you can see some good examples of what makes Raven Rock plant life unique to this area. Along the ridge above are mountain laurel and rhododendron. At the base of the seepage isa small patch of galax. These plants are usually found in the mountains of North Carolina but can grow here because of the orientation of the cliff face. Looking at the topographic map, you will notice that Raven Rock has a north facing cliff. Since the sun rises in the east, sets in the west, and at midday is always slightly to the south in this latitude, the north face of the cliff remains shadier, cooler and moister than areas across the river. This is the same reason you often find moss growing on the lower trunk of a tree on the side facing north; it is one way to find north if you are lost without a compass.

Another type of habitat, right beneath your feet, is the **floodplain**. These red clay soils are a product of weathering. Erosion carries clays and other sediments downstream and deposits them in areas like this during periods of receding high water. Some of the clays can be seen on the trees along the river. With the clay is organic debris which makes



mountain laurel

the floodplain very fertile. This habitat provides an excellent opportunity for wildflower and tree seeds that dropped in the water up-river to gain a foothold and thrive.

Station 6:
Fall Zone

The overlook located at point B on your Station 5 topographic map provides an excellent vantage point from which to view part of the fall zone as well as to observe the effects of river erosion and deposition.

The fall zone is an area where the metamorphic rocks of the piedmont meet the sedimentary rocks of the coastal plain. Where major rivers cross this line on the way to the ocean, you can find numerous rapids like those at Fish Traps, seen just upstream.

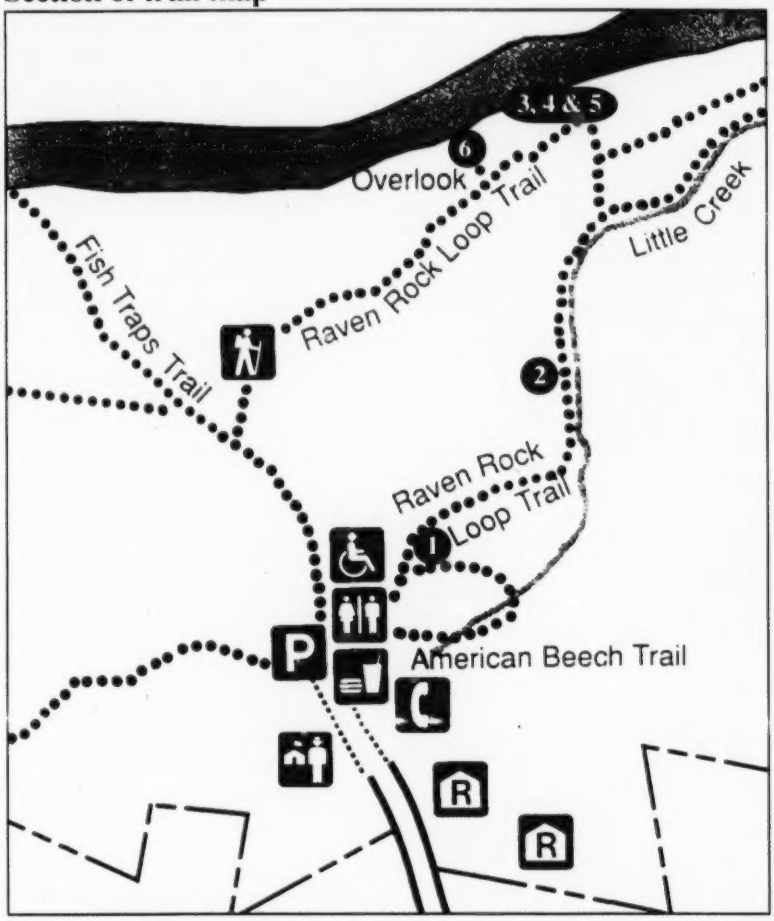
The rapids result from different rates of weathering and erosion between the sedimentary and metamorphic rocks, causing a change in elevation in the river bed.

Like the stream at Station 2, rivers meander. The Station 5 map shows the contour lines on the south side of the river close together, indicating that the slope on the south side is much steeper than the north side. The floodplain extends a considerable distance over the north river bank. Erosion is taking place on the south bank and deposition is taking place on the north bank.

Looking west, you will see Fish Traps Rapids. Just east of Fish Traps you can see several rock piles in the river covered with vegetation. This is evidence of another process that can change the shape of a river. These rock piles are the remains of the Norrington Lock and Dam, which allowed steamboats to pass over the rapids. Most of the dams like this one were destroyed by a flood in 1858, prior to the Civil War. They were not rebuilt due to the war. After the war, river transportation was replaced by another mode of travel – railroads.

On this hike, you have seen how erosion and deposition can change the land around us. You have seen how weathering plays a very important part in completing the rock cycle, how the weathered rocks might be moved and deposited as valuable soil to eventually become sedimentary rock. You have also discovered how Raven Rock might have been formed and learned some methods of identifying rocks and minerals that make up this grand natural structure.

Section of trail map



Student's Information

One thought that occurs to anyone visiting Raven Rock is "how did it get there and how was it named?" On this hike we will see some of the forces that have combined to form this impressive natural monument.

Geologists theorize that sediments were deposited in a shallow sea here 500 to 800 million years ago. As layers of sand, composed of quartz, feldspar and mica, fell to the sea floor, they compacted to form sedimentary rocks called sandstone. About 300 to 500 million years ago, the deeply buried sandstone was changed by heat and pressure into metamorphic rocks called gneiss and quartzite. Eventually the metamorphic rocks were slowly arched upward and exposed at the land surface by weathering and erosion.

As a result of its geologic history, Raven Rock has played an important part of this area's cultural history. It was a choice campsite for Native Americans. At one time, the rock was called Patterson's Rock. In the 1740's, Gilbert Patterson wrecked his canoe at Fish Traps Rapids and sought shelter at the base of Raven Rock until his rescue.

Some of the rock was used in the 1850's to construct the Norrington Lock and Dam at Fish Traps so that steamboats could cross the rapids on their way from Fayetteville to Chatham County. It was during this period that the rock was called Raven Rock, since ravens were observed nesting on the rock. Ravens are no longer found here but do still live in the western part of the state. Other accounts indicate the rock was named "Reaven's Rock" as early as 1773 and one legend notes that the rock was named after a Tuscarora tribal leader known as Raven.

Now that you have learned some theories on how the rock formed and how it got its name, we will embark on a hike to discover some of the mysteries that still change this natural wonder, even today. Along the way, you will record some of your observations on your worksheet.

Station Summaries:

Station 1

At this station you will examine some rocks on the path and use simple descriptive terms to describe their characteristics. We will discuss forces that could produce this sort of rock.

Station 2

By examining the stream and its banks, at this station, you will determine where erosion and deposition are taking place, as well as what effect these have on the stream's route.

Station 3

a) In the first activity of this station, you will use two standard testing procedures to determine the identities of two different, but similar appearing minerals.

b) Next, you will discover the identities of three common minerals found at Raven Rock, by observing the way they break, their surface appearance and their hardness. We will then discuss how these minerals combine to form the primary rock that makes up Raven Rock.

Station 4

Here, you will be able to observe some of the weathering processes that have changed Raven Rock into what we see today and how these processes relate to completing the rock cycle.

Station 5

a) First, we will orient a contour map of Raven Rock using a compass and observe the surrounding topography.

b) Then, we will see how topography can affect the rocks and soils in an area and observe what effect the land contour has on the type of plants that grow in this area.

Station 6

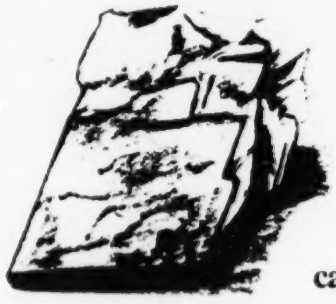
From this last station at the overlook, you will be able to see evidence that we are located in the fall zone and of how the river is changing Raven Rock's landscape.

Mineral Fact Sheet

Mineral	Hardness	Luster	Color	Fracture/ Cleavage	Remarks
Feldspar	6	Glassy	Colorless to various colors	In two planes at or near 90 degrees	Most common mineral in igneous rock, clay used in making ceramics
Quartz	7 – 8	Glassy	Colorless to various colors	Irregular shell-like surface; crystals hexagonal	Many varieties are gems; used to make glass
Calcite	3	Glassy, greasy	Colorless to various colors	In three planes but not at 90 degrees	Reacts with acids

Mohs Hardness Scale

Scale Number	Mineral	Common Objects
1	Talc	
2	Gypsum	scratch fingernail
3	Calcite	scratch penny
4	Fluorite	
5	Apatite	scratch knife blade
6	Feldspar	scratch file
7	Quartz	
8	Topaz	
9	Corundum	
10	Diamond	



calcite

feldspar

quartz

Worksheet for GeoTrek at Raven Rock State Park

Station 1 (Pet Rock)

Examine the rocks on the path. Pick a rock that fits easily in your hand. Now, get to know this rock – look at its size (big or small), shape (round, square, oval, flat), texture (rough, smooth), color, etc. Describe your rock below.

_____

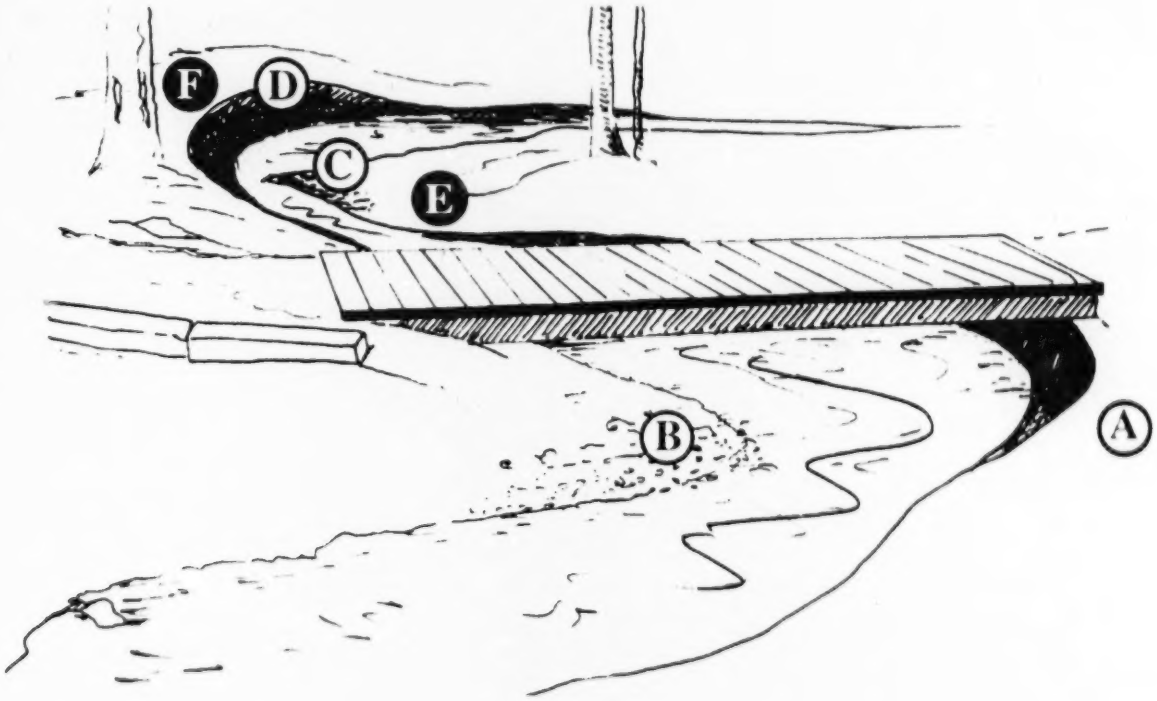
_____

_____

_____

Station 2 (Give & Take)

Observe the actual parts of the stream banks as shown in this drawing.



Circle the letters that represent:

1. Which banks are higher? A&D or B&C
2. On which banks are sediments and pebbles being deposited? A B C D
3. From which banks are soil and rocks being eroded? A B C D
4. Are stream banks C & D moving towards point E or F?

Station 3-A (Mineral Test)

Here are some mineral samples similar to those found in the Raven Rock wall. Though the minerals look similar, some simple tests can determine differences.

Test 1 (Effervescence):

Place a drop of dilute acid on each sample. Does it bubble (effervesce)? Record either yes or no in the chart below.

Test 2 (Hardness):

Attempt to scratch the glass plate with each sample. Does it scratch the glass? Record either yes or no in the chart.

Test 3 (Name):

Place the correct name for each sample in the chart.

- Quartz is made of silica, much like glass. Due to its hardness, it can scratch glass. It does not react to a dilute acid.
- Calcite (calcium carbonate) is relatively soft (3 on the Mohs hardness scale) and reacts to acid much like baking soda (sodium bicarbonate) does to vinegar (acid). "Tums™," an antacid that neutralizes stomach acid, is made of calcium carbonate.

	Effervesces	Scratches glass	Name
Sample A			
Sample B			

Station 3-B (Hard Rock Café)

Before you are three mineral samples. Determine each sample's identity by comparing it with the mineral fact sheet (page 4.1.9). Fill in the information in the chart below.

	Hardness	Luster	Cleavage	Mineral Name
Sample A				
Sample B				
Sample C				

Station 4 (Breaking up is not hard to do)

1. At your feet is a rubble pile of rocks that have broken off from the rock face. Is this an example of: A) mechanical weathering B) chemical weathering

2. What erosion agent placed them here? A) wind B) gravity

3. Look for any evidence of people's ability to weather rocks. How many drill holes, filled with black powder, were required to break one of the rocks? _____

4. The trees on the rock overhang have roots that grow into existing cracks or fractures. As these roots expand, they can spread rocks apart and are considered a means of:

A) mechanical weathering B) chemical weathering

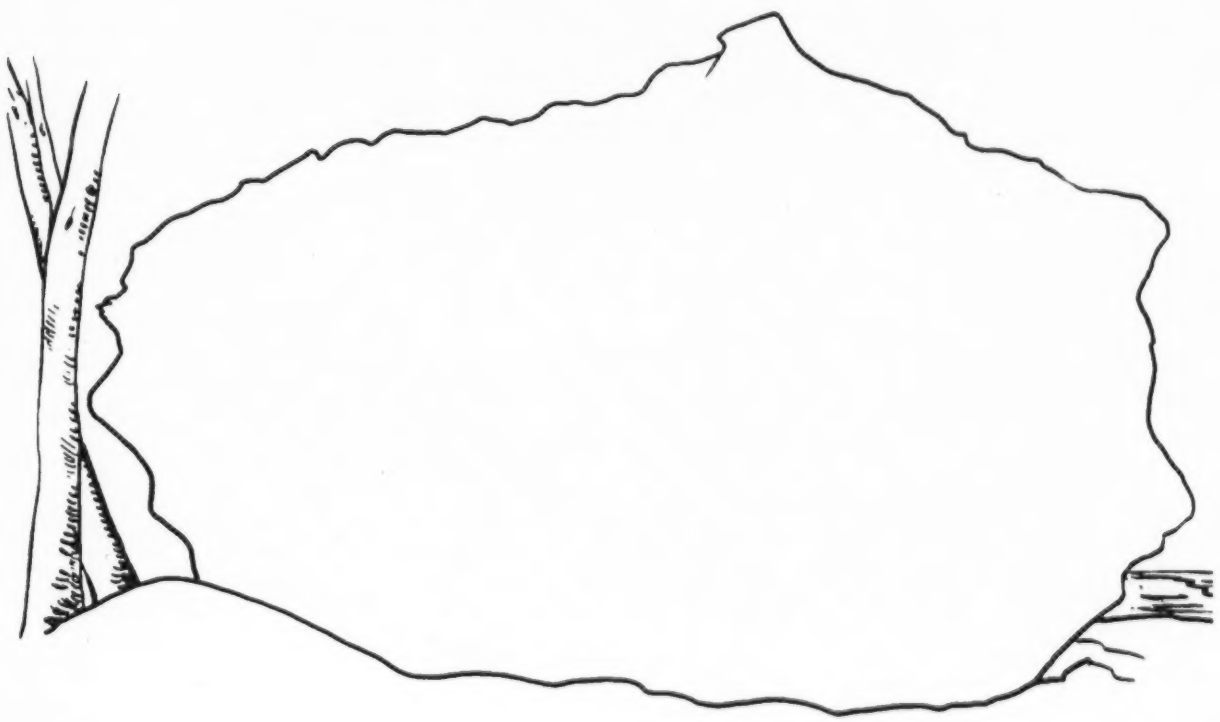
5. During freezing weather, what other agent of mechanical weathering may be active?

A) ice B) snow C) neither A nor B

6. As weathering has exposed the rock face, you can observe the results of geological processes that span millions of years. Are distinct layers of rock visible? A) yes B) no

If so, draw a sketch of the layers on the diagram of the rock face.

Label on the diagram of the rock face any rock layers, any cracks or fractures, color and other features.



Station 5-A (Cool & Wet)

Notice the pattern of weathered and eroded rock in this area.

1. The quartz veins are:

A) more resistant than the surrounding rock. **B)** less resistant than the surrounding rock.

2. The rocks here are normally:

A) wetter than nearby rocks. **B)** dryer than nearby rocks.

How can you tell? _____

_____

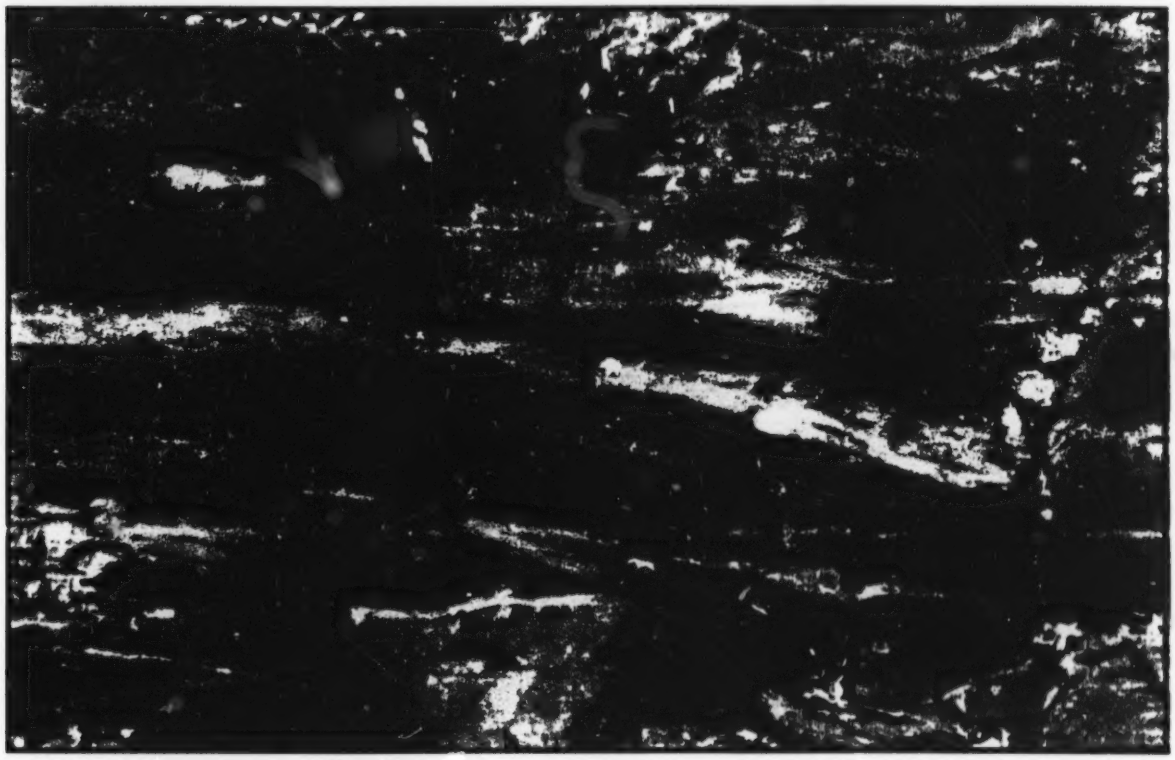
Slow moving water created the eroded rocks you see.

Water that seeps into rocks may dissolve minerals and wash them away in a process called **leaching**. If the water contains weak acids, it can dissolve rock-forming minerals like calcite. Water can also chemically combine with minerals in rock; this is called **hydration**. When this happens, the outside minerals become soft and brittle and eventually flake off the rock, forming soil.

These newly formed soils are usually clays, much of which are hydrated from feldspar. Feldspar is a common mineral in soils and rock, and the hydration of feldspar to clay is a widespread example of:

A) mechanical weathering **B)** chemical weathering.

Iron oxides (rust) give the clays at your feet and the quartz rock at the picnic area their reddish color. Oxidation is another example of _____ weathering.



Station 5-B (Topo RARO)

Observe the map of Raven Rock. Each contour line on this topographic map represents 10 feet. The closer the lines are together, the steeper the slope will be. Now, let's find out where we are. We know we are near the river, but on which side? One way to find out is to use a compass.

a. Rotate the dial on the compass until North is at the index mark (white mark near the mirror).

b. Next, hold the compass level and note the direction of the red arrow.

c. Now, turn your body until the red needle is lined up with North on the dial. The compass, and you, are now pointing north.

d. Holding the map flat, rotate the map until the north indicator on the map is pointing in the same direction as the compass. The map is now properly oriented and the river should appear on the map as it does from your location. Maps usually show only the north direction. Fill in the West, South and East points on the map.

1. We are at: A) point A. B) point B.

2. The river is: A) North B) South of us.

3. Observing the river at this point, the water is moving from: A) right to left. B) left to right.

4. We are on the river bank with the: A) steep slope. B) flat slope.

5. What direction do the cliffs face: N S E W

6. Since the sun rises in the east, sets in the west, and at its highest point during the day is slightly toward the south in North Carolina, this side of the river bank is usually:

A) shadier & moister B) sunnier & drier than the other side.

This is the same reason you often see moss growing on the lower trunk of a tree on the side facing north; that is one way to find north if you are lost without a compass.

7. At the top of the water seepage are shrubs called mountain laurel and rhododendron. Plants called galax are located along the slope and at the base of the seepage. All of these plants prefer mountain habitats but can thrive here due to A) warmer B) cooler conditions that exist here.

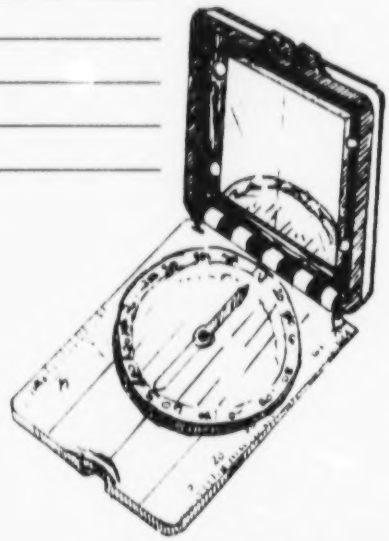
8. What animals' signs have we seen, or what animals do you think call the Raven Rock cliffs home? _____

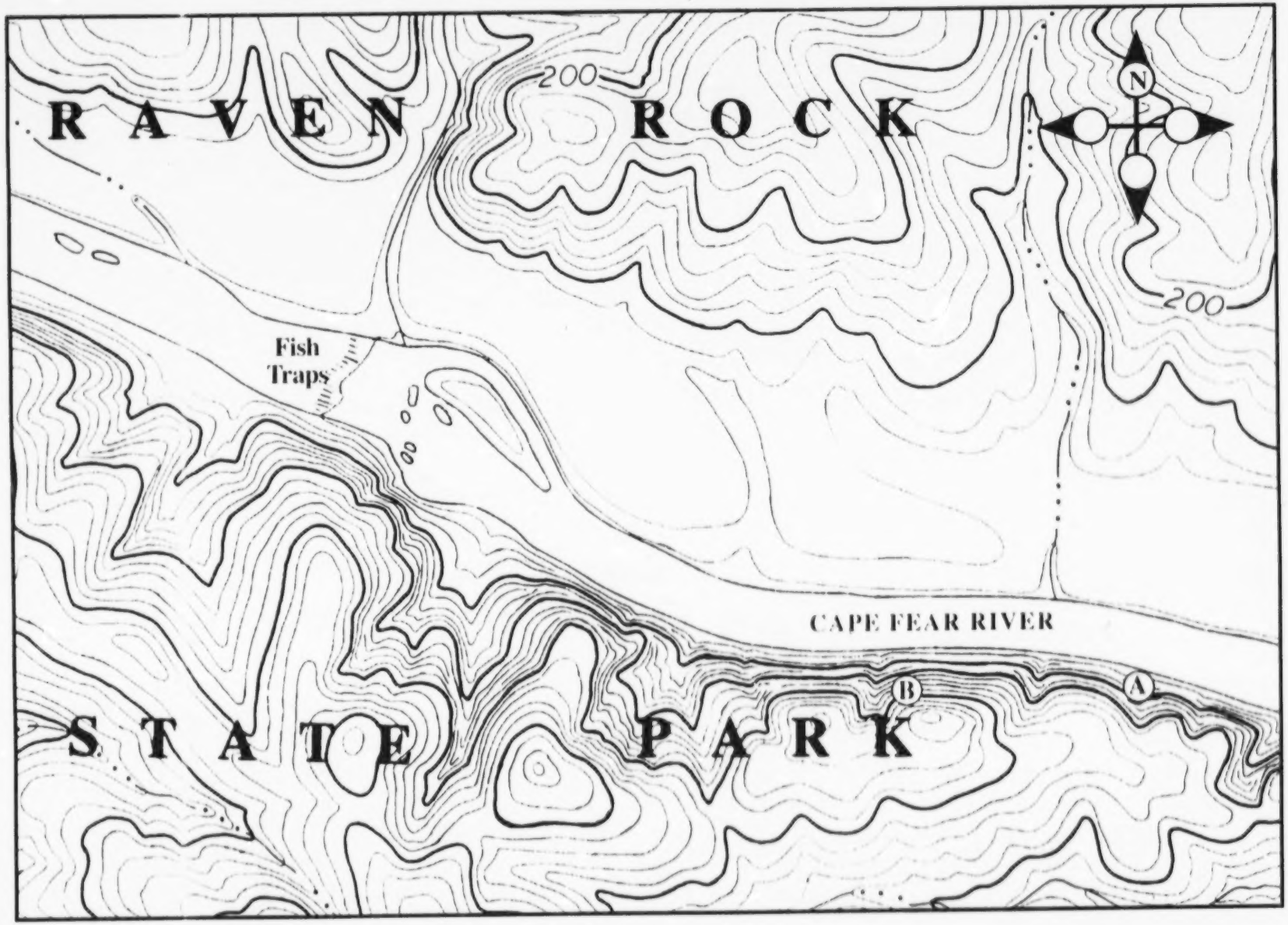
_____

_____

_____

_____





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Raven Rock State Park, NC

4115

May 1994

STATION 6 (I can see for miles)

Look at the map from Station 5. You are now located at Point B.

1. Which bank of the Cape Fear River is higher?

A) north side B) south side

2. Based on your observations at the small stream, which side of the river do you think is being eroded?

A) north side B) south side

3. From these observations, in which direction do you think the river banks in this area are shifting?

A) North B) South

4. If you look upstream, toward the west, you will see a set of rapids called Fish Traps. This area lies on the fall zone where rivers pass over A) harder B) softer metamorphic rocks of the piedmont to the A) harder B) softer sedimentary rocks of the coastal plain. The different erosion rates of the rock types cause a gradient, or change in the level of the river bed, creating whitewater such as those at Fish Traps.

Answer Sheet for GeoTrek at Raven Rock State Park

Station 1 (Pet Rock)

Examine the rocks on the path. Pick a rock that fits easily in your hand. Now, get to know this rock – look at its size (big or small), shape (round, square, oval, flat), texture (rough, smooth), color, etc. Describe your rock below.

Example answer: I can hold my rock easily in my hand. It is round in shape and slightly rough in texture.

A small area has chipped away and I can see that the rock's inside is a lighter color than the outside.

Station 2 (Give & Take)

Observe the actual parts of the stream banks as shown in this drawing.

Circle the letters that represent:

1. Which banks are higher? (A&D) or B&C
2. On which banks are sediments and pebbles being deposited? A (B) (C) D
3. From which banks are soil and rocks being eroded? (A) B C (D)
4. Are stream banks C & D moving towards point E or (F)?

Station 3-A (Mineral Test)

Here are some mineral samples similar to those found in the Raven Rock wall. Though the minerals look similar, some simple tests can determine differences.

Test 1 (Effervescence):

Place a drop of dilute acid on each sample. Does it bubble (effervesce)? Record either yes or no in the chart below.

Test 2 (Hardness):

Attempt to scratch the glass plate with each sample. Does it scratch the glass? Record either yes or no in the chart.

Test 3 (Name):

Place the correct name for each sample in the chart.

- Quartz is made of silica, much like glass. Due to its hardness, it can scratch glass. It does not react to a dilute acid.
- Calcite (calcium carbonate) is relatively soft (3 on the Mohs hardness scale) and reacts to acid much like baking soda (sodium bicarbonate) does to vinegar (acid). "Tums™," an antacid that neutralizes stomach acid, is made of calcium carbonate.

	Effervesces	Scratches glass	Name
Sample A	*no*	*yes*	*quartz*
Sample B	*yes*	*no*	*calcite*

Station 3-B (Hard Rock Cafe)

Before you are three mineral samples. Determine each sample's identity by comparing it with the mineral fact sheet (page 4.1.9). Fill in the information in the chart below.

	Hardness	Luster	Cleavage	Mineral Name
Sample A	*7*	*glassy*	*none*	*quartz*
Sample B	*3*	*glassy/greasy*	*yes*	*calcite*
Sample C	*6*	*glassy*	*yes*	*feldspar*

Station 4 (Breaking up is not hard to do)

1. At your feet is a rubble pile of rocks that have broken off from the rock face. Is this an example of: (A) mechanical weathering B) chemical weathering

2. What erosion agent placed them here? A) wind (B) gravity)

3. Look for any evidence of people's ability to weather rocks. How many drill holes, filled with black powder, were required to break one of the rocks? *at least 14*

4. The trees on the rock overhang have roots that grow into existing cracks or fractures. As these roots expand, they can spread rocks apart and are considered a means of:

(A) mechanical weathering) B) chemical weathering

5. During freezing weather, what other agent of mechanical weathering may be active?

(A) ice) B) snow C) neither A nor B

6. As weathering has exposed the rock face, you can observe the results of geological processes that span millions of years. Are distinct layers of rock visible? (A) yes) B) no

If so, draw a sketch of the layers on the diagram of the rock face. Label on the diagram of the rock face any rock layers, any cracks or fractures, color and other features.

light gray layer; layering obvious; many round-edged nooks and crannies
moderately gray layer; layering obvious; many sharp-edged nooks and crannies
light gray layer; layering obvious; almost no nooks and crannies; very few lichens
medium gray layer; few nooks and crannies, gray and black lichens common

Station 5-A (Cool & Wet)

Notice the pattern of weathered and eroded rock in this area.

1. The quartz veins are:

(A) more resistant than the surrounding rock. **B)** less resistant than the surrounding rock.

2. The rocks here are normally:

(A) wetter than nearby rocks. **B)** dryer than nearby rocks.

How can you tell? *During wet spells they will be noticeably wetter. During dry spells the presence of mosses, lichens and other green plants on rock surfaces indicates they are usually wetter.*

Slow moving water created the eroded rocks you see.

Water that seeps into rocks may dissolve minerals and wash them away in a process called **leaching**. If the water contains weak acids, it can dissolve rock-forming minerals like calcite. Water can also chemically combine with minerals in rock; this is called **hydration**. When this happens, the outside minerals become soft and brittle and eventually flake off the rock, forming soil.

These newly formed soils are usually clays, much of which are hydrated from feldspar. Feldspar is a common mineral in soils and rock, and the hydration of feldspar to clay is a widespread example of:

A) mechanical weathering. (**B)** chemical weathering.)

Iron oxides (rust) give the clays at your feet and the quartz rock at the picnic area their reddish color. Oxidation is another example of *chemical* weathering.

Station 5-B (Topo RARO)

Observe the map of Raven Rock. Each contour line on this topographic map represents 10 feet. The closer the lines are together, the steeper the slope will be. Now, let's find out where we are. We know we are near the river, but on which side? One way to find out is to use a compass.

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d. Holding the map flat, rotate the map until the north indicator on the map is pointing in the same direction as the compass. The map is now properly oriented and the river should appear on the map as it does from your location. Maps usually show only the north direction. Fill in the West, South and East points on the map.

1. We are at: (A) point A B) point B.

2. The river is: (A) North B) South of us.

3. Observing the river at this point, the water is moving from: A) right to left. (B) left to right.)

4. We are on the river bank with the: (A) steep slope.) B) flat slope.

5. What direction do the cliffs face: (N) S E W

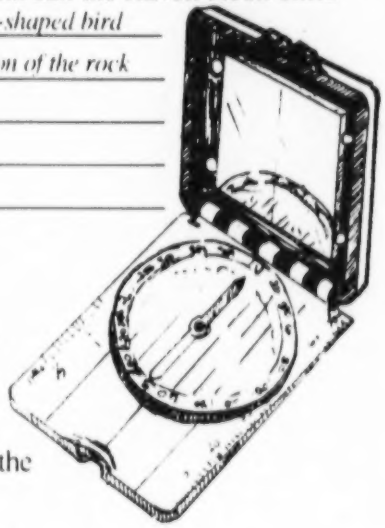
6. Since the sun rises in the east, sets in the west, and at its highest point during the day is slightly toward the south in North Carolina, this side of the river bank is usually:

(A) shadier & moister B) sunnier & drier than the other side.

This is the same reason you often see moss growing on the lower trunk of a tree on the side facing north; that is one way to find north if you are lost without a compass.

7. At the top of the water seepage are shrubs called mountain laurel and rhododendron. Plants called galax are located along the slope and at the base of the seepage. All of these plants prefer mountain habitats but can thrive here due to A) warmer (B) cooler conditions that exist here.

8. What animals' signs have we seen, or what animals do you think call the Raven Rock cliffs home? *The clay tunnels constructed by the mud dauber wasp and the cup-shaped bird nest of the phoebe can be readily seen. If you have the time, close inspection of the rock face might reveal small insects using the nooks and crannies.*



STATION 6 (I can see for miles)

Look at the map from Station 5. You are now located at Point B.

1. Which bank of the Cape Fear River is higher?

A) north side (B) south side

2. Based on your observations at the small stream, which side of the river do you think is being eroded?

A) north side (B) south side

3. From these observations, in which direction do you think the river banks in this area are shifting?

A) North (B) South

4. If you look upstream, toward the west, you will see a set of rapids called Fish Traps. This area lies on the fall zone where rivers pass over (A) harder B) softer metamorphic rocks of the piedmont to the A) harder (B) softer sedimentary rocks of the coastal plain. The different erosion rates of the rock types cause a gradient, or change in the level of the river bed, creating whitewater such as those at Fish Traps.

Post-Visit Activity #1 — GeoJeopardy

Curriculum Objectives:
Grade 5
- Communication Skills: listening, reading, vocabulary and viewing comprehension, speaking techniques
- Guidance: group interaction
- Science: earth science, environment
- Social Science: organize and analyze information, draw conclusions, participate effectively in groups

Grade 6
- Communication Skills: listening, reading, vocabulary and viewing comprehension, speaking techniques
- Guidance: group interaction
- Science: earth science, environment
- Social Studies: evaluate, organize and analyze information, draw conclusions

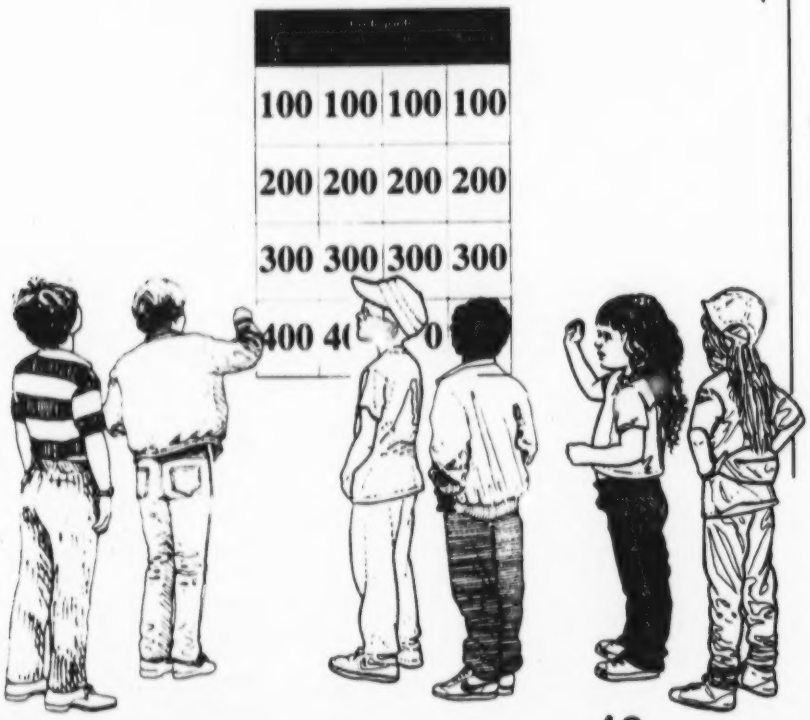
Grade 7
- Communication Skills: listening, reading, vocabulary and viewing comprehension, speaking techniques
- Guidance: group cooperation
- Science: earth science, earth forms and natural phenomena
- Social Studies: organize and analyze information, draw conclusions

Locations:
Inside or outside, depending on the weather

Group Size:
30 or less, larger groups can be accommodated

Estimated Time: 30 minutes

Materials:
Provided by the educator:
GeoJeopardy Board



Educator's Information:

This game is adapted from the television game show, Jeopardy. Before starting the game, be sure to briefly review the "Introduction to the Geology of Raven Rock State Park" in the Introduction section. This is a fun way for the students to evaluate themselves on what they have learned through the previous activities. The game also provides good factual information on geology, and on Raven Rock in particular. You may wish to award prizes or recognition to the participants with the highest score.

Major Concepts:
- Basic rock types
- Weathering and erosion
- Rock and mineral characteristics

Objectives:
- List the three basic rock types.
- Describe how rocks change through weathering and erosion.
- Distinguish between rocks and minerals.
- Know the basic characteristics of select rocks and minerals.

Instructions:

Divide the class into three teams. Put each team in a line facing the Jeopardy Board. Ask one of the three students at the head of the lines to pick the first number amount and category column to be revealed. The amounts do not have to be selected in any particular order.

When the category and the amount have been selected, uncover the "answer" and read it aloud to the group. The first of the three students at the head of the lines to raise a hand gets a chance to respond. (It is extremely helpful to have someone familiar with the group to watch for the first hand raised, since the leader will be reading the "answers.")

The correct response must be in the form of a question. If the first student answers incorrectly, the other two students are given a chance to raise their hands and respond. The student who correctly responds by asking "What is _____." receives the point value card and gets to select the next category and amount to be revealed. If no correct response is given, the leader gives the response.

All three participants now move to the back of the lines and the next three students have a chance to answer the next question.

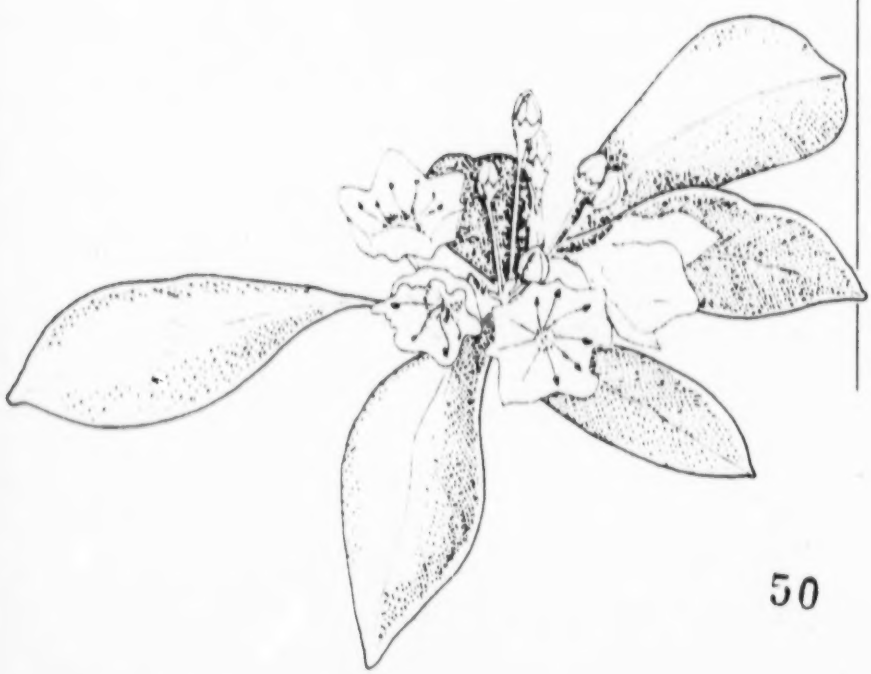
After all columns have been uncovered, each team adds up their point cards to determine who has the most points. If any prizes are to be awarded, that is done at this time.

Suggested Extensions:

Play another television game called Win, Lose or Draw. Geological terms or processes are written on index cards which are placed face down on a table close to the chalkboard where the drawings will be done. Try to have different colors of chalk available.

Divide the class into two groups. Each group will choose someone to draw for that group. One point is given for each correct guess. The first group's "artist" has one minute to convey a geological term or process in pictures to their group. If the group doesn't guess the correct answer in one minute, the other group has a chance to guess what was being drawn. If neither group gets the correct answer, the moderator (usually a teacher) gives the answer.

It is now the second group's turn. A new index card is taken from the stack and the second group's "artist" draws a picture to convey the term to their group. Suggestions for geological terms or processes that could be used are: erosion, weathering, crystal, sedimentary rock, igneous rock, metamorphic rock, volcanoes, etc.



GeoJeopardy			
Raven Rock Recipe	Shake, Rattle and Roll	Hard Rock Buffet	Mineral Mysteries: Solved!
100	100	100	100
200	200	200	200
300	300	300	300
400	400	400	400

GeoJeopardy

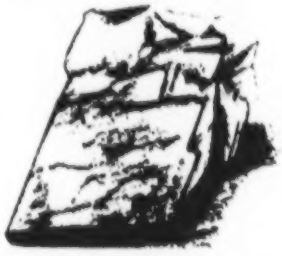
Raven Rock Recipe	Shake, Rattle and Roll	Hard Rock Buffet	Mineral Mysteries: Solved!
A soft white mineral that bubbles when dilute acid is placed on it.	The process that loosens and carries away the rock debris caused by weathering.	Cemented or compressed sediments form this type of rock.	This test is used to indicate the presence of carbonates and works well on calcite.
A sometimes colorful mineral made of silicon that occurs in veins and is used in glass and watch crystals.	Ice, tree roots, abrasion, people.	"Fire rock" is formed by melting rock. None have been found at Raven Rock.	Dull, glassy, pearly, metallic, or greasy.
This is the most abundant mineral in the earth's crust. White to pinkish in color, it weathers into clay; used in ceramics.	The lifting or folding of rocks form these. Their presence promotes weathering.	Rock formed by heat and pressure is this type. These rocks make up Raven Rock.	Fingernail, copper, penny, knife blade, window glass, and steel file.
A "very good" metamorphic rock that shows banding from the separation of mica from quartz and feldspar.	Water, acids.	The area where rivers flow from hard Piedmont metamorphic rocks to softer Coastal Plain sedimentary rock, creating rapids.	The way a mineral breaks is described by this term.

Geo.Jeopardy - Correct Responses			
Raven Rock Recipe	Shake, Rattle and Roll	Hard Rock Buffet	Mineral Mysteries: Solved!
What is calcite?	What is erosion?	What is sedimentary?	What is an acid test?
What is quartz?	What are agents of mechanical weathering?	What is igneous?	What is luster?
What is feldspar?	What are joints or fractures?	What is metamorphic?	What is a hardness test?
What is gneiss?	What are agents of chemical weathering?	What is the fall zone?	What is fracture or cleavage?

VOCABULARY

Abrasion - Process of rubbing or grinding two objects together.

Calcite - A mineral composed of calcium carbonate.



Carbonate - A chemical composed of carbon and oxygen.

Chemical weathering - Process that changes the minerals in rocks, resulting in a weakening of the rocks.

Cleavage - Property of a mineral that causes it to break along one or more smooth, flat surfaces.

Contour interval - Vertical distance between two contour lines.

Contour line - Line on a topographic map that connects points of equal elevation.

Coriolis effect - The effect of the earth's rotation that causes winds and ocean currents to shift to the right or left of their expected paths.

Crystal - The many sided form that is the outward sign of an orderly arrangement of atoms within a mineral.

Density - A descriptive term for a mineral, comparing the mineral's mass to its volume.

Deposition - Process by which materials, carried by the agents of erosion, are dropped elsewhere.

Element - One of the 103 basic substances of the universe that cannot be broken into a more simple substance by either chemical or physical means. Gold and diamonds (carbon) are examples of elements with pure forms.

Erosion - Movement of weathered rock and soil from one place to another.

Extrusive igneous rock - Igneous rock that forms on the earth's surface.

Fall zone - An area where hard, metamorphic rocks meet softer sedimentary rocks, resulting in uneven river erosion, creating rapids.

Fault - A break or crack in a rock along which the rock moves.

Feldspar - The most abundant silicate mineral in the earth's crust. It often breaks down, or weathers, into clays.

Flood plain - Flat land bordering a river onto which floodwaters flow.

Foliated - Metamorphic rocks in which minerals have been rearranged into visible layers or bands.

Fracture - The characteristic splintered, uneven or curved-surface break of minerals which lack cleavage.

Geology - The study of the solid part of the earth and the processes that act on it.

Gneiss - (nice) A metamorphic rock with banding or foliation caused by the separation of mica from quartz and feldspar during metamorphism.

Hydration - Weathering process by which water combines with certain minerals in rock.

Ice wedging - A mechanical weathering process, when water seeps into cracks in rocks, then freezes and expands, widening the crack and eventually splitting the rock.

Igneous rock - Rock formed from cooling magma.

Intrusive igneous rock - Igneous rock formed deep inside the earth.

Joint - A crack in a rock.

Leaching - Process by which water dissolves and carries away minerals.

Luster - Property of how a mineral reflects light.

Magma - A hot liquid rock below the earth's surface. When magma reaches the surface, it is called lava.

Meander - The circuitous winding of a stream or river, caused by the uneven erosion of its banks.

Mechanical weathering - Type of weathering which breaks rocks apart without changing their mineral composition.

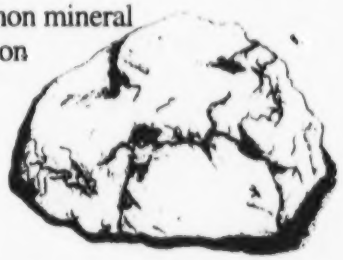
Metamorphic rock - Rock altered by heat or pressure.

Mica - A silicate mineral family easily recognized by its dark colors and its capacity to easily be split into characteristic thin, pearly sheets.

Mineral - A naturally occurring substance composed of one or more elements in known proportions. Though rare in nature, some elements such as gold and diamond, can occur in pure form and technically can also be called rocks and minerals. Quartz, containing the elements silicon and oxygen, is a common mineral found in the park.

Oxidation - Process by which certain minerals combine with oxygen in the air or water.

Quartz - A common mineral composed of silicon dioxide.



Rock - Natural solid materials composed of one or more minerals.

Rock cycle - The set of processes that describe how rocks change from one type to another.

Sediment - Material that settles to the bottom of a liquid, such as soil being washed into a lake and settling to the bottom.

Sedimentary rock - Rock that forms near the earth's surface by processes that often involve the cementing or compressing of sediments.

Silicate - Mineral containing the elements silicon and oxygen.

Solution - A mixture in which one or more substances is dissolved in another.

Streak - The color left behind when the mineral is rubbed across the surface of a piece of unglazed white porcelain.

Topographic map - A map that shows the shape and elevation of the land surface.

Vein - A band of rock that forms when minerals, such as those dissolved in water, enter cracks in rocks.

Weathering - Processes by which rocks are broken down as a result of exposure to weather.

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SCHEDULING WORKSHEET

For office use only:
Date request received _____ Request received by _____

1) Name of group (school) _____

2) Contact person _____ _____
name phone (work) (home)

_____
address

3) Day/date/time of requested program _____

4) Program desired and program length _____

5) Meeting place _____

6) Time of arrival at park _____ Time of departure from park _____

7) Number of students _____ Age range (grade) _____
(Note: A maximum of 30 participants is recommended.)

8) Number of chaperones _____
(Note: One adult for every 10 students is recommended.)

9) Areas of special emphasis _____

10) Special considerations of group (e.g. allergies, health concerns, physical limitations) _____
_____

11) Have you or your group participated in park programs before? If yes, please indicate previous programs attended: _____
_____

12) Are parental permission forms required? _____ If yes, please use the Parental Permission form on page 8.2.

I, _____, have read the entire Environmental Education Learning Experience and understand and agree to all the conditions within it.

Return to: Raven Rock State Park
Rt. 3, Box 1005
Lillington, NC 27545

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PARENTAL PERMISSION FORM

Dear Parent:

Your child will soon be involved in an exciting learning adventure - an environmental education experience at _____. Studies have shown that such "hands-on" learning programs improve children's attitudes and performance in a broad range of school subjects.

In order to make your child's visit to "nature's classroom" as safe as possible we ask that you provide the following information and sign at the bottom. Please note that insects, poison ivy and other potential risks are a natural part of any outdoor setting. We advise that children bring appropriate clothing (long pants, rain gear, sturdy shoes) for their planned activities.

Child's name _____

Does your child:

- Have an allergy to bee stings or insect bites?_____
  If so, please have them bring their medication and stress that they, or the group leader, be able to administer it.

- Have other allergies? _____

- Have any other health problems we should be aware of?_____
  _____

- In case of an emergency, I give permission for my child to be treated by the attending physician. I understand that I would be notified as soon as possible.

_____ _____
Parent's signature date

Parent's name _____ Home phone _____
(please print) Work phone _____

Family Physician's name _____ phone _____

Alternate Emergency Contact

Name_____ phone _____

NORTH CAROLINA PARKS & RECREATION
PROGRAM EVALUATION

Please take a few moments to evaluate the program(s) you received. This will help us improve our service to you in the future.

1. Program title(s) _____ Date _____

   Program leader(s) _____

2. What part of the program(s) did you find the most interesting and useful? _____

   _____

3. What part(s) did you find the least interesting and useful?_____

   _____

4. What can we do to improve the program(s)?_____

   _____

   _____

5. General comments _____

   _____

   _____

   _____

LEADERS OF SCHOOL GROUPS AND OTHER ORGANIZED YOUTH GROUPS
PLEASE ANSWER THESE ADDITIONAL QUESTIONS:

6. Group (school) name _____

7. Did the program(s) meet the stated objectives or curriculum needs? _____

   If not, why? _____

   _____

Please return the completed form to park staff. Thank you.

Raven Rock State Park
Rt. 3, Box 1005
Lillington, NC 27545